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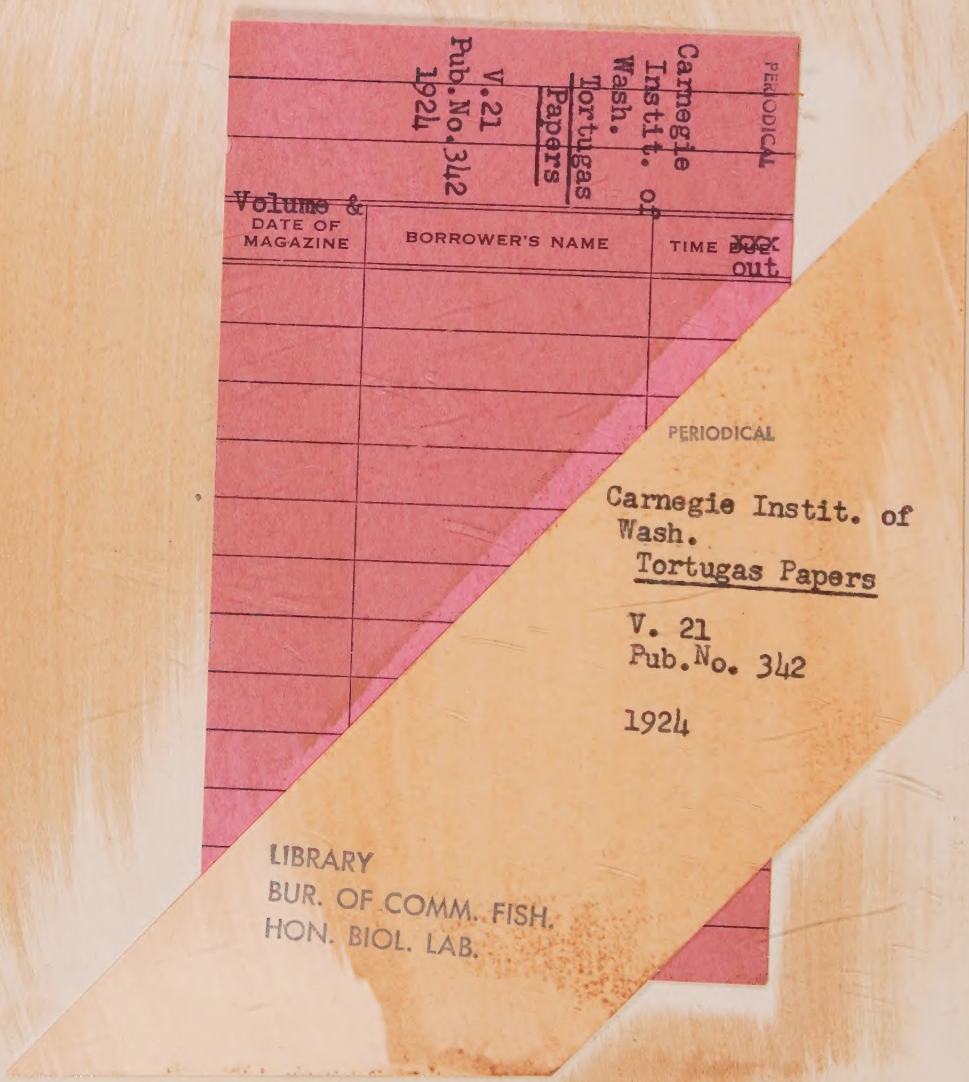

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DEPARTMENT OF MARINE BIOLOGY
OF
THE CARNEGIE INSTITUTION OF WASHINGTON

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SAMOAN FORAMINIFERA

BY

JOSEPH AUGUSTINE CUSHMAN

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SAMOAN FORAMINIFERA.

By Joseph Augustine Cushman.

INTRODUCTION.

The present paper gives the results of a study of collections made by the late Dr. Alfred G. Mayor at Samoa in 1920. The location of Samoa in a generally central position as regards the islands of Polynesia makes it interesting and typical of such conditions. The *Challenger* dredged extensively at Fiji, about New Guinea, and in Torres Straits the results of which have given a good idea of the fauna to the west of Samoa. With the exception of a few records from Tahiti, little is known of the distribution to the east. The works of Chapman on the Funafuti collections to the northwest of Samoa make possible interesting comparisons.

A table accompanying this paper gives something of the distribution of this Indo-Pacific fauna which is characteristic of Polynesia in general and extends westward about the shores of the Indian Ocean through Ceylon to the eastern coast of Africa. In this part of the ocean are living to-day many ancestral types known elsewhere only by fossils. From this point alone the foraminiferal fauna of the Polynesian region is intensely interesting.

There are very many new species in the region. Brady, in spite of his ultra conservatism, was forced to describe many new species from the collections made by the *Challenger*. The one regret is that he did not describe more of them as new rather than refer so many of them to species which now prove to have little in common with these Indo-Pacific ones. Fortunately, Brady chose many of these specimens for his *Challenger* Report figures, and through the kindness of Capt. F. A. Potts, of Trinity College, I have notes of many of the originals which are now in the Brady collection at Cambridge. Thus it is possible to use the *Challenger* figures in a more intelligent manner than would otherwise be the case.

Millett, in his work on the Malay Archipelago, also was forced to describe as new, species which were strikingly different from those of other regions. Heron-Allen and Earland have added a number of new species from the Kerimba Archipelago, many of which occur at Samoa.

In spite of the work of these various authors, it has been imperative to add many new names, as a comparison has been made of Brady's *Challenger* figures with the original species to which he refers them.

With this study I am more and more convinced that the shallower water foraminiferal faunas are as limited in their geographical distribution as many other groups of organisms and that there are very many more species of such genera as *Quinqueloculina, Spiroloculina,* etc., living about oceanic islands and elsewhere than have been suspected. The constancy of form, outline, apertural characters, and ornamentation at many stations in the same faunal area is very striking when these are closely compared with specimens from other areas. With this closer study will come the recognition of definite faunal areas such as are known from other groups.

With a few exceptions, the figures are from drawings made by Mr. J. Henry Blake. For his services I am indebted to the Carnegie Institution of Washington.

RELATION OF THE SAMOAN FAUNA TO THOSE OF OTHER REGIONS.

Although the Samoan collections were very small in size, they give a very good idea of the foraminiferal fauna of the region. There is a considerable diversification of depths and bottom conditions. Station 9, especially, in deeper water, 50 fathoms, adds many species which are of especial interest and of rare occurrence. It tends to show the adaptation of various species to local habitats and the restricted range of many of the shallow water species.

The excellent work of Heron-Allen and Earland on the collections from the Kerimba Archipelago off Southeastern Africa has shown the close relation of that fauna and the fauna of the Polynesian Islands. Our collections here make this even more evident. The relationship to Hawaii, Philippine region, the Malay region, and Funafuti is shown in table 1, as well as the few that occur in the Tortugas region. The close relationship to the Lower Oligocene faunas of Mississippi and Alabama has been already noted in papers on those faunas (Prof. Paper 129, U. S. Geol. Surv., 1922, 133, 1923).

STATIONS AND DATA.

There are nine definite stations from which material was collected by the late Dr. Alfred G. Mayor and sent to me for study. From the large number of species occurring only at station 9, it is apparent that an extension of the collecting to deeper water would have added many other species.

Station No.

1. 25 fathoms off Utilei Reef, Pago Pago Harbor, Samoa. June 30, 1920.
2. 17 fathoms, between Breaking Rock and Experiment Reef Patch off north end of Aua Reef. July 3, 1920.
3. 13 fathoms, west by north of A Buoy 500 feet, Pago Pago Harbor, Samoa. July 6, 1920.
4. 12 fathoms, midway between A Buoy and north shore of Pago Pago Harbor, Samoa. July 6, 1920.
5. 18 fathoms off north end of Aua Reef, midway between Breaking Rock and Experiment Reef Patch. July 3, 1920.
6. 17 fathoms, muddy bottom from one-third the distance from Oceanic S. S. Co. buoy, toward Mooring Buoy A, Pago Pago Harbor, Samoa. July 2, 1920.
7. 16 fathoms, at Mooring Buoy A, Pago Pago Harbor, Samoa. July 1, 1920.
8. 12.5 fathoms, near Mooring Buoy A, Pago Pago Harbor, Samoa. July 16, 1920. Hard mud, full of "worm holes."
9. 50 fathoms, south of Breaker Point, between the mouth of Pago Pago Harbor and Taema Bank, Tutuila, Samoa. (This is from the submerged bottom of the old barrier reef lagoon surrounding Tutuila.)

The columns marked by the succeeding letters show records for the various species at the following localities:

A. Aua Reef, in shallow water.
K. Kerimba Archipelago, off Southeastern Africa.
P. Philippines.
F. Funafuti.
H. Hawaii.
T. Tortugas Region.
M. Malay Archipelago.
U. Occurrences in the Tertiary of the Coastal Plain of United States. O.=Oligocene. M.=Miocene. P.=Pliocene.

TABLE 1.

Species.	Station.																
	1	2	3	4	5	6	7	8	9	A	K	P	F	H	T	M	U
Nouria harrisii					+							+			+		
Carterina fulva									+								
Rotaliammina mayori									+								
Haplophragmoides sphæriloculum									+								
Textularia folium									+		+		+	+			O
siphonifera									+			+	+	+			
foliacea	+	+	+	+	+	+		+	+		+	+					
rugosa	+										+	+	+		+		
conica	+				+			+			+	+	+		+	+	O
gramen		+								+	+	+	+	+		+	P
hauerii									+		+						
catenata									+			+			+		
sp.?									+								
Bolivina hantkeniana									+			+		+		+	
tenuis	+								+								
simpsoni									+		+						
tortuosa									+		+		+				
compacta		+							+						+		
mayori	+		+						+		?				+		
limbata, var. costulata	+	+	+		+				+		+		+		+		
vertebralis									+								
sp.?									+								
Bifarina mackinnonii									+		+					+	
Verneuilina spinulosa	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	
Chrysalidina dimorpha									+		+	+		+	+	+	
Gaudryina triangularis, var. angulata	+				+				+		?						
Clavulina pacifica	+	+	+		+					+	?	+					
difformis	+	+	+		+	+					+	+					
Mimosina echinata									+		+						
Buliminella elegantissima									+		+		+			+	
Buliminoides williamsoniana									+		+			+	+	+	
Virgulina subsquammosa									+			+					
Cassidulina lævigata									+		+	+	+				
Lagena bicarinata, var									+								
Cristellaria crepidula									+			+		+		+	
Triplasia tricarinata									+				+	+		+	
Uvigerina porrecta	+								+		+		+			+	
interrupta									+			+	+	+		+	
Siphogenerina raphanus	+	+			+	+		+			+		+	+	+	+	
virgula	+	+	+			+			+		+		+			+	
columellaris									+		+	+	+	+		+	
Globigerina bulloides	+					+			+		+	+	+	+	+	+	O
æquilateralis						+		+			+	+	+	+		+	
conglobata	+								+		+	+	+	+		+	
digitata									+			+	+	+			
rubra	+								+		+	+	+	+	+	+	
sacculifera									+			+	+	+		+	M
Spirillina vivipara	+	+	+		+				+		+		+		+		
limbata										+	+	+	+			+	
limbata, var. tuberculolimbata		+							+			+		+			
inæqualis	+										+		+	+		+	
spinigera									+				+				
sp.?									+								

TABLE 1—*Continued.*

Species.	Station.																
	1	2	3	4	5	6	7	8	9	A	K	P	F	H	T	M	U
Patellina advena	....	....	....	....	....	....	....	....	+	....	?	?	+	....	....	?	O
Discorbis subbertheloti	....	....	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....
patelliformis	....	+	....	....	+	....	....	....	....	+	+	....	+	....	....	+	O
Cymbalopora bradyi	+	+	....	+	+	....	....	....	+	+	....	....	....	....	....	....	....
tabellæformis	....	....	....	....	+	....	....	+	+	....	+	....	+	....	....	+	....
Tretomphalus bulloides	....	....	....	....	....	....	....	....	+	....	+	....	+	+	+	....	....
milletti	....	....	....	....	....	....	....	....	+	....	+	....	....	....	....	+	....
Planorbulina larvata	....	....	....	....	+	....	....	....	+	....	+	+	+	+	....	....	O
acervalis	....	+	....	....	....	....	....	....	....	....	+	....	+	+	+	....	....
Truncatulina rostrata	+	+	+	+	+	+	....	+	+	+	+	+	+	....	....	....	....
tubulifera	....	+	+	....	....	....	....	....	....	....	+	....	....	....	....	....	....
mayori	+	+	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....
haidingeri, var. pacifica	+	+	+	+	+	....	....	....	+	....	....	+	....	....	....	....	....
Anomalina glabrata	+	+	....	....	....	+	....	....	+	....	....	....	....	....	....	....	....
Siphonina echinata	....	....	....	....	....	....	....	....	....	+	+	....	....	+	....	+	....
tubulosa	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
Pulvinulina peroblonga	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
mayori	+	+	....	....	....	....	....	....	....	....	?	....	?	....	....	+	....
favus	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
repanda	....	+	+	....	+	....	....	....	....	....	+	+	+	....	+	+	....
Rotalia soldanii	....	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....
venusta	....	....	....	....	....	....	....	....	....	+	+	....	....	....	....	+	....
murrayi	....	....	+	....	....	....	....	....	....	....	+	....	....	....	....	....	....
Calcarina mayori	+	+	+	....	+	....	....	....	....	+	....	....	....	....	....	....	....
Baculogypsina sphærulatus	+	....	....	....	....	....	....	+	....	+	....	+	+	....	....	+	....
Gypsina globulus	....	....	....	....	....	....	....	....	....	+	+	+	+	....	....	....	....
inhærens	+	....	....	....	....	....	....	....	....	....	+	....	+	....	....	+	....
vesicularis, var. squamiformis	+	....	....	....	....	....	....	....	+	....	?	....	+	....	....	....	....
Polytrema miniaceum	+	....	....	....	....	....	....	....	....	....	+	+	+	....	....	....	....
Nonionina scapha	....	+	....	....	....	....	+	....	+	....	+	....	+	+	....	+	O
subturgida	....	....	....	....	....	....	+	....	+	....	....	....	....	....	....	....	....
umbilicatula, var. pacifica	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Polystomella milletti	....	+	....	....	....	....	....	....	....	....	+	....	....	....	....	+	....
advena	+	+	+	....	....	....	+	+	+	....	+	....	+	+	+	+	....
jenseni	....	+	+	....	+	....	....	....	+	....	....	....	....	....	....	....	....
sp.?	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Amphistegina madagascarensis	+	....	....	....	+	....	....	....	+	+	+	+	....	....	....	....	....
radiata	+	....	....	....	+	....	....	....	+	+	+	+	....	....	....	....	....
Operculina gaimairdi	+	+	....	....	+	....	....	....	....	....	....	+	....	....	....	....	....
bartschi, var. plana	....	....	....	....	....	....	....	....	+	....	....	+	....	....	....	....	....
Operculinella venosa	+	....	....	....	....	....	....	....	....	....	+	+	....	+	....	+	....
Heterostegina suborbicularis	....	+	+	....	....	....	....	....	+	....	....	+	....	....	....	....	....
Cornuspira involvens	+	....	....	....	....	+	....	....	+	....	+	+	+	+	+	+	....
Nubecularia tubulosa, var. subdecorata	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
lucifuga	....	+	....	....	....	....	....	....	....	....	+	....	+	....	....	+	....
Nubeculina divaricata, var. advena	+	+	+	....	....	....	....	....	+	....	+	....	+	....	....	+	....
divaricata, var. gracilis	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
Nodobacularia tibia	+	....	....	....	....	....	....	....	....	....	+	+	+	....	+	+	....
Fischerina pellucida	....	+	....	....	....	....	....	....	....	....	+	....	....	....	....	+	....
Tubinella funalis	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
chapmani	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
Spiroloculina antillarum	+	+	....	....	+	+	....	....	+	+	+	+	+	+	+	....	O
antillarum, var. angulata	+	+	....	....	+	....	....	....	+	+	....	+	+	....	+	....	....
grateloupi	+	+	+	....	+	+	....	+	+	....	....	+	....	....	+	....	O
mayori	+	+	+	....	+	....	....	....	+	....	+	....	....	....	....	....	....
acutimargo	....	+	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
eximia	+	....	....	+	....	....	+	....	....	....	....	....	....	....	+	....	....
affixa	+	....	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....
canaliculata	+	....	....	....	+	....	....	....	....	....	?	+	....	+	....	?	....
planissima	+	....	....	....	....	....	....	....	+	....	+	....	....	....	....	....	....
planissima, var. samaoensis	+	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Vertebralina striata	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....
Quinqueloculina alveoliniformis	+	+	....	....	+	....	....	....	....	....	+	+	+	....	+	+	....
samaoensis	+	....	+	+	+	+	+	+	+	....	....	....	....	....	....	....	....
bidentata	+	+	....	....	....	....	....	....	....	+	....	....	....	....	+	....	P

TABLE 1—*Continued.*

Species.	Station.															
	1	2	3	4	5	6	7	8	9	A	K	P	F	H	T	M	U
Quinqueloculina parkeri	+	+	+	....	+	....	....	....	....	+	+	+	+	+	?	+	....
anguina	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....
anguina, var. agglutinans	+	+	....	....	+	....	....	....	+	....	+	....	....	....	....	....	....
disparilis, var. curta	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....
kerimbatica	+	....	....	....	....	....	+	....	....	....	+	+	....	....	....	+	....
kerimbatica, var. philippinensis	+	....	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....
striata	....	+	....	....	....	....	....	....	....	....	?	....	....	?	....	....	....
bicostata	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
vulgaris	+	+	....	....	....	....	....	....	+	....	+	+	....	+	....	....	O
spiralis	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
undosa	....	+	....	....	....	....	....	....	+	....	+	....	+	....	....	....	....
crassa, var. subcuneata	+	....	....	....	....	....	....	....	....	+	+	+	....	....	....	....	....
lamarckiana	....	....	+	....	....	+	+	....	....	....	....	+	....	....	+	....	O
seminulum	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....	....
tropicalis	....	....	+	....	+	....	....	....	....	....	....	....	....	....	....	+	....
polygona, var	+	+	+	....	+	....	....	....	....	....	....	....	....	....	....	....	....
species?	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Massilina alveoliniformis	+	....	....	....	....	....	....	....	....	....	+	+	....	....	+	+	....
macilenta	....	....	+	....	+	....	....	....	+	....	?	....	+	+	....	?	....
exsculpta	....	....	....	....	....	....	....	....	+	....	+	....	....	....	....	....	....
crenata	....	....	....	....	....	....	....	....	+	....	+	+	+	....	+	+	....
pacificensis	+	....	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....
annectens	....	+	....	....	....	....	....	....	....	....	+	....	....	+	....	....	....
Articulina antillarum	....	....	....	....	....	....	....	....	+	....	?	....	....	....	+	?	....
sp.?	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....
Hauerina ornatissima	+	+	....	....	+	....	+	....	+	....	+	+	+	+	+	+	P
fragilissima	....	....	....	....	+	....	....	....	+	....	+	+	+	....	+	+	O
Triloculina tricarinata, var. convexa	+	....	+	+	+	+	+	+	+	+	+	+	....	....	....	....	....
tricarinata, var	+	....	+	+	....	+	....	....	....	....	....	....	....	....	....	....	....
circularis	+	+	....	....	+	+	....	....	....	....	+	+	+	+	+	+	....
oblonga	+	+	+	....	+	+	....	....	+	....	....	....	....	....	....	....	....
Biloculina denticulata	+	....	....	....	+	....	....	....	+	....	+	+	+	+	+	+	....
denticulata, var. striolata	....	+	+	....	....	....	....	....	....	....	+	+	....	+	+	+	....
millettii	....	....	+	+	....	+	....	....	....	....	+	+	....	....	+	+	....
Peneroplis pertusus	....	....	....	....	....	....	....	....	....	+	+	+	+	+	+	+	P
Orbitolites marginalis	+	+	....	....	+	....	....	....	+	....	+	+	+	....	....	+	P
duplex	+	....	....	....	....	....	....	....	+	+	+	+	+	+	+	....	....
complanata	....	....	....	....	....	....	....	....	....	+	+	+	+	....	....	+	....

Family LITUOLIDÆ.

Genus NOURIA Heron-Allen and Earland, 1913.

Nouria harrisii Heron-Allen and Earland.

(Plate 1, Figure 1.)

Nouria harrisii Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1914, p. 376, pl. 37, figs. 16 to 20.

Test free, fusiform or pyriform, cylindrical or subcylindrical in section; chambers 2 to 4 in an irregularly spiral arrangement; sutures indistinct from the surface; wall composed of a single layer of sponge-spicules arranged generally lengthwise of the test and with a variable amount of cementing material; aperture circular, terminal.

Length about 0.5 mm.

As noted by the original authors, there is a tendency for this species to have one or more spicules extend out beyond the base of the test. The selective power of the organism is also marked, as the bottom samples show comparatively few acerose sponge-spicules, showing that the organism must have to go over a considerable amount of bottom to find enough spicules to form its test. The test itself is delicate and friable, so that specimens may be more frequent than appears from the records.

The distribution of the species is apparently limited to tropical seas. The following records are known: Off Cebu, Philippines, 120 fathoms; Java Sea, 45 fathoms; Sahul Bank, Timor Sea, 50 fathoms; and off Old Providence Island, Caribbean Sea, 382 fathoms (Heron-Allen and Earland).

The present record from Samoa, station 5, gives a station somewhat remote from the others, but nevertheless still in the same general faunal region.

Genus CARTERINA H. B. Brady, 1884.

Carterina fulva Cushman, new species.

(Plate 1, Figure 3.)

Carterina spiculotesta Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 620 in part?.

Test rotaliform, slightly longer than broad, compressed; chambers 7 or 8 in the last-formed coil; sutures distinct but not depressed on the dorsal side, slightly more so on the ventral side; wall very thin, translucent, composed largely of fusiform bodies, irregularly scattered; aperture on the ventral side toward the umbilicus; color yellowish-brown throughout.

Length 0.4 mm.

This differs from the typical species in its fulvous color throughout, the greater height of the coil of the test, the smaller size and less definite arrangement of the spicular bodies. Heron-Allen and Earland, in their paper referred to above, note that in their collections from the Kerimba Archipelago they had two forms of this genus, and this species may be the same as the smaller of their two forms.

It was very rare at Samoa, in the collection from station 9.

Genus ROTALIAMMINA Cushman, new genus.

Test rotaliform, attached by the ventral side, all chambers visible from above, only those of the last-formed coil from below; chambers numerous with thick arenaceous walls of matted spicules, the areas between softer and somewhat flexible; aperture ventral, along the growing edge of the test.

Type species, *Rotaliammina mayori* Cushman, new species.

This genus is peculiar in its mass of material separating the chambers on the dorsal side, the open ventral side, and the general soft, flexible wall.

Rotaliammina mayori Cushman, new species.

(Plate 1, Figures 4 and 5.)

Test rotaliform, attached by the ventral side; chambers numerous, all visible from the dorsal side, only those of the last-formed coil from the ventral side, no basal surface apparent, about 10 chambers in the last-formed coil, chambers tapering to a point near the umbilicus, peripheral end rounded; wall thick, of fragments of sponge-spicules and fine amorphous material, the whole more or less flexible; sutures not apparent on the dorsal side, the outer portions of the chambers appearing as dark-brownish areas in the general mass of grayish-white amorphous material; aperture apparently at the outer edge of the chamber, at the growing edge.

Diameter up to 0.6 mm.

This species was obtained from station 9 of the Samoan samples collected by Dr. A. G. Mayor, after whom it is named.

The species should be looked for in similar tropical material.

Genus HAPLOPHRAGMOIDES Cushman, 1910.

Haplophragmoides sphæriloculum Cushman.

(Plate 1, Figure 2.)

Haplophragmoides sphæriloculum Cushman, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 107, fig. 165 (in text); Bull. 104, U. S. Nat. Mus., pt. 2, 1920, p. 44, pl. 8, fig. 3.

Haplophragmium sphæriloculum Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 15, pl. 2, figs. 15, 16.

Test free, planospiral, 5 or 6 chambers in the last-formed coil, partially involute, periphery deeply lobulated; chambers inflated; sutures depressed; wall finely arenaceous, smoothly cemented; aperture a short, narrow slit at the base of the final chamber; color light yellowish-brown.

Diameter about 0.5 mm.

A few specimens of the general character of this species were obtained in the collection from station 9.

It has occurred off the coast of Japan and in the Atlantic off the eastern coast of South America, in the Gulf of Mexico, off the eastern coast of the United States (Cushman), and off the east coast of Australia (Sidebottom).

Family TEXTULARIIDÆ.

Genus TEXTULARIA Defrance, 1824.

Textularia folium Parker and Jones.

(Plate 7, Figure 2.)

Textularia folium Parker and Jones, Philos. Trans. Roy. Soc., vol. 155, 1865, pp. 370, 420, pl. 18, fig. 19.—Moebius, Beitr. Meeresfauna Insel Mauritius, 1880, p. 92, pl. 8, figs. 16, 17.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 357, pl. 42, figs. 1–5.—Egger, Abh. kön. bay. Akad. Wiss München, Cl. II, vol. 18, 1893, p. 272, pl. 6, figs. 27, 28.—Chapman, Journ. Linn. Soc. London (Zoology), vol. 28, 1900 (1902), p. 184.—Rhumbler, Zool. Jahrb., Abteil. Syst., vol. 24, 1906, p. 59, pl. 5, figs. 51, 52.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907 (1909), p. 127, pl. 9, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 130.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 19, figs. 31–33 (in text).—Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 623.—Cushman, Prof. Paper 129–E, U. S. Geological Survey, 1921, p. 90, pl. 14, fig. 3.

Test free, very much compressed, broad and triangular in front view, the apertural end usually broadly convex, in end view narrow, widest near the middle, thence tapering toward the rather acute lateral margins; chambers broad and low in the adult, somewhat curved; sutures thickened, peripheral margin thin; wall rather coarsely perforate, proloculum rounded or quadrangular, periphery often with thick spines, usually two, on opposite sides of the test near the base, but sometimes with additional ones near the base.

Length usually not more than 0.5 mm.

The species occurred only at the deeper station 9 in the Samoan collection. It is a species that seems to be confined to comparatively shallow water in tropical seas. The only fossil record seems to be that of my own from the Byram marl, lower Oligocene of the United States. As a recent species it is recorded from shore sand, Melbourne (Parker and Jones); Mauritius, rare, from the intestine of *Maretia planulata* (Moebius); off East Moncoeur Island, Bass Strait, 38 fathoms; off Raine Island, Torres Strait, 155 fathoms; off Kandavu, Fiji, 255 fathoms; off Levuka, Fiji; Nares Harbor, Admiralty Islands, 17 fathoms; Honolulu coral-reefs, 40 fathoms (H. B. Brady); Mauritius and East Australia (Egger); from the lagoon at Funafuti; shore sands of Victoria (Chapman); shallow water off Laysan Island (Rhumbler); off the Hawaiian Islands, 305 fathoms (Bagg; 249 and 271 fathoms, Cushman); and a single specimen from the Kerimba Archipelago, 5 to 10 fathoms (Heron-Allen and Earland).

I did not find it in any of the collections I had from the Philippines, nor did Millett record it from his material from the Malay Archipelago.

The lateral spines are peculiar. They seem to be independent of individual chambers and are evidently added during the life of the individual. The apertural area is flattened, depressed in the central portion where the edge of the new chamber overlaps the preceding one, and the whole covered with rather prominent papillæ which in front view may be seen projecting slightly above the outline of the test.

Moebius figures plastogamic individuals, and I found them also in the Samoan collection. One is usually much smaller than the other.

It seems somewhat of a question as to whether this is really a species of *Textularia*. It is very different from most of the species of that genus in the material of the wall and in the apertural chambers.

Textularia siphonifera H. B. Brady.

(Plate 3, Figure 5; Plate 4, Figures 4, 5.)

Textularia siphonifera H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 53; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 362, pl. 42, figs. 25 to 29.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 17, figs. 28, 29 (in text); Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 115, pl. 21, figs. 4 to 7.

Spiroplecta siphonifera Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1909 (1910), p. 272, pl. 53, fig. 1.

Test free, elongate, subcylindrical, tapering toward the initial end, which is often somewhat flattened and twisted; end view broadly oval with usually 6 or sometimes 8 projecting portions; chambers low and broad, the earlier ones flattened and produced into fistulae, the later ones with three or four projections, forming vertical rows with those of the chambers directly above and below; ends of the projections originally closed and bluntly rounded, but usually in adult specimens broken open; wall arenaceous; surface slightly roughened.

Length of Samoan specimens, which are immature, hardly more than 1 mm.

A very few, apparently young specimens, occurred in the material from station 9. One of these shown in plate 4, figure 5, shows the early portion of the microscopic form with the flattened test and fistulose projections. The other, plate 4, figure 4, shows a specimen in which the accessory projecting portions are just beginning to appear, being seen in the last two chambers of each side. These are unusual in being nearly all complete and closed. Plate 3, figure 5, shows a young specimen which may be possibly a young megalospheric specimen of this species.

The species is known from the Indo-Pacific only. Brady's original specimens were from *Challenger* stations off the coral reefs of Honolulu, 40 fathoms; 2 stations off the Admiralty Islands, 15 to 25 fathoms; from off Tongatabu, Friendly Islands, 18 fathoms; and Gulf of Suez, 30 fathoms. Bagg had it from off Hawaii, in 1,307 fathoms. Chapman recorded it from off Funafuti, and I have had it from the North Pacific from off Hawaii, 55 and 323 fathoms, and from off Blake reef, Southern Japan, 316 fathoms. It occurred at numerous stations in the Philippine area, most commonly at 25 fathoms or less. It is interesting to note that Heron-Allen and Earland did not record this species in their rich tropical gatherings from Kerimba Archipelago, where numerous species in common with those of Samoa are found. I did not find it in the material from Murray Island, Great Barrier Reef, collected by Dr. Mayor. Its distribution, therefore, is somewhat restricted, although it occurs widely distributed in the tropical Pacific.

Textularia foliacea Heron-Allen and Earland.

(Plate 2, Figures 2 to 4, Plate 3, Figure 1.)

Textularia foliacea Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 628, pl. 47, figs. 17 to 20.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 117, pl. 19, figs. 7*a*, *b*.

Test of medium size, much compressed, triangular, the outer apertural end broadly convex; chambers numerous, 9 to 11 on each side in the adult; sutures fairly distinct but only slightly depressed; surface roughly formed, of sand-grains so cemented as to leave a characteristic rough, somewhat flaky surface; aperture fairly large, curved, at the base of the last-formed chamber, with a slight lip.

Length 1 to 1.5 mm.

This species occurs as typical and fairly abundant specimens at all but 1 of the 8 numbered stations, as the table shows. It was originally described by Heron-Allen and Earland from the Kerimba Archipelago and recorded from Timor Sea, Java, 50 fathoms; off Vavau, South Pacific, 16 fathoms; from off Fiji and "Coral Reef, Australia," 17 fathoms. I recorded it from 7 stations off the Philippines, at depths ranging from 20 to 494 fathoms. It has evidently a wide range in the Indo-Pacific, being characteristic of comparatively shallow water of coral-reef regions.

Textularia rugosa (Reuss)

(Plate 3, Figure 2.)

Plecanium rugosum Reuss, Sitz. Akad. Wiss. Wien, vol. 59, 1869, p. 453, pl. 1, figs. 3*a*, *b*.
Textularia rugosa H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 363, pl. 42, figs. 23, 24.—Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 625, pl. 47, figs. 7 to 9.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 114, pl. 23, figs. 3, 4.

Test longer than broad, compressed; chambers numerous, broader than high, with the basal portion with a concave area near the periphery; sutures distinct, slightly depressed; wall coarsely arenaceous, but rather neatly finished; aperture crescentiform, at the base of the last-formed chamber.

Length of Samoan specimens which are evidently not fully developed, about 1.5 mm.

Specimens were found from station 1.

This is a common species of the general Indo-Pacific region in comparatively shallow water. It is especially well developed in the Philippines, where it occurs abundantly at stations in less than 40 fathoms.

Very rare poorly developed specimens from the Tortugas region seem to indicate that the species may occur sparingly in the warmer parts of the Western Atlantic, but it is not well developed there.

Textularia conica d'Orbigny.

(Plate 1, Figure 6.)

Textularia conica d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiferes," p. 143, pl. 1, figs. 19, 20.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 365, pl. 43, figs. 13, 14; pl. 113, fig. 1.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 50, pl. 11, figs. 4 to 6; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 123, pl. 25, figs. 2*a* to *e*; Carnegie Inst. Wash. Pub. 311, 1921, p. 24, pl. 2, fig. 4.

Test usually somewhat wider than high, triangular in front view, broadly oval in end view, in adults with the sides of the last-formed chambers nearly parallel, apex bluntly pointed; chambers comparatively few, distinct; sutures fairly distinct, only slightly if at all depressed; wall arenaceous, the surface fairly smooth; aperture a narrow opening at the base of the inner margin of the last-formed chamber in a depression of the apertural face, usually with a slight overhanging lip; color grayish-white.

Length of the Samoan specimens not exceeding 0.6 mm.

This species was described by d'Orbigny from shallow water in the West Indies, and in the warmer parts of the Atlantic it seems to be in considerable numbers. In the Pacific very similar forms occur, such as is figured here.

Specimens occurred at Samoan stations 1, 5, and 8.

Textularia gramen d'Orbigny.

(Plate 1, Figures 7, 8.)

Textularia gramen d'Orbigny, Foram. Foss. Vienne, 1846, p. 248, pl. 15, figs. 4, 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, 1884, p. 365, pl. 43, figs. 9, 10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 8, figs. 6 to 8 (in text); Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 105, pl. 20, fig. 7.

Test rather short and broad, thick, subconical, increasing rapidly in diameter; chambers broad and low, the lateral borders acutely angled, the early chambers compressed; sutures often indistinct; wall arenaceous, sometimes rough; aperture elongate, slit-like, in the indentation near the base of the inner border of the chamber.

Length 1 to 1.5 mm., microspheric proloculum 0.014 mm., megalospheric proloculum 0.05 mm.

Specimens which may be referred to this species occurred in shallow water on the reef and also at station 2. It may be questioned whether the form figured here, which occurs commonly in shallow water of the Indo-Pacific, is really the same as that from the Tertiary of Central Europe. It is one of the specific names under which have been put a great many things.

Textularia hauerii d'Orbigny.

(Plate 2, Figure 5.)

Textularia hauerii d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 250, pl. 15, figs, 13 to 15.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915. p. 628, pl. 47, figs. 21 to 23.

Textularia gramen (in part), H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 365.

Test comparatively large and stout, with about 8 chambers on a side, inflated, the sutures rather indistinct, wall coarsely arenaceous; aperture elongate, at the base of the ventral side of the chamber.

Length, up to 1.25 mm.

Heron-Allen and Earland refer to this species of d'Orbigny specimens from the Kerimba Archipelago off southeastern Africa. Many of the species of Kerimba are identical with those of Samoa, and this seems to be one of them. Whether this species from Kerimba and Samoa is specifically the same as that of d'Orbigny from the Vienna Basin may be doubted.

Specimens were rare in the Samoan collections and only occurred at the deepest station, 9, in 50 fathoms.

Textularia catenata Cushman.

(Plate 2, Figures 6, 7.)

Textularia catenata Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 23, figs. 39, 40 (in text); Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 112, pl. 23, fig. 5; Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 12, pl. 6, fig. 3.

Test elongate, rounded in end view, composed of inflated chambers, about 8 on each side, periphery somewhat lobulate; sutures distinct, depressed; wall somewhat coarsely arenaceous, but rather smoothly finished; aperture in the early chambers slit-like at the ventral border of the inner margin, in later chambers gradually moving away from the margin, and in the last-formed chamber subterminal and rounded.

Length, about 1 mm.

Specimens occurred only at the deepest station, 9, in the Samoan collection. I have referred to this species which was originally described from the North Pacific in deep water, specimens from the Philippines in 193 fathoms and in the Atlantic from off Fowey Rocks, Florida, in 70 fathoms, as well as a few stations in deep water in the Western Atlantic. These latter, however, are referred to this species somewhat questionably.

Textularia sp.?

(Plate 2, Figure 1, Plate 4, Figure 6.)

There are a very few specimens of a small tapering *Textularia* which occurs only at the deepest station, 9, in 50 fathers. Two of these are figured here, but I have not felt warranted with the rather meager and poorly characterized material in placing it under a definite specific name.

Genus BOLIVINA d'Orbigny, 1839.

Bolivina hantkeniana H. B. Brady.

(Plate 6, Figures 1, 2.)

Bolivina hantkeniana H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 424, pl. 53, figs. 16 to 18.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 296, pl. 8, figs. 40 to 42.—Millett, Journ. Roy. Micr. Soc., 1900, p. 546, pl. 4, fig. 9.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 137.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 42, fig. 68 (in text).—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 127.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 132, pl. 27, fig. 1.

Test broad, much compressed, usually completely surrounded except at the aperture by a broad wing-like flange, either entire or variously lobed; chambers inflated somewhat; sutures very distinct, slightly depressed;

wall calcareous, with a few short longitudinal costae, usually confined to the limits of the chamber on which they originate; aperture narrow, oval, with a single tooth-like projection in the orifice; color white.

Length 0.6 to 0.84 mm.

This species is confined, so far as present knowledge is available, to the Indo-Pacific. It seems to be most frequently met with in dredgings from some depth. It occurred only in the Samoan collection from station 9, which was in 50 fathoms. This may account for the fact that Heron-Allen and Earland did not find it in their Kerimba dredgings. The original stations given by Brady are off Tahiti, 420 and 620 fathoms; off Kandavu, Fiji, 210 and 255 fathoms, off New Hebrides, 130 fathoms, and off Aru Island, 800 fathoms. Egger records it from off West Australia in 359 meters. Millett's stations are in the Malay region. Bagg recorded it in deep water from off the Hawaiian Islands. I had it from off the southern coast of Japan in 500 fathoms and Sidebottom from off the coast of Australia in 465 fathoms. In the Philippine and adjacent regions to the south I had the species from 13 stations, ranging in depth from 26 to 1,262 fathoms. It is noteworthy in this connection to find it was common only at 3 stations, the depths of which were 220, 221, and 554 fathoms, agreeing well with other records.

Bolivina tenuis H. B. Brady.

(Plate 5, Figures 7, 8.)

Bolivina tenuis H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 57; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 419, pl. 52, fig. 29.

Test much compressed, nearly as broad as long, widest just above the middle; chambers comparatively few, fairly distinct; sutures strongly curved, the inner portion of each chamber showing signs of a subdivision in some cases; wall smooth; aperture at one side, rounded, with a very slight lip.

Length about 0.25 mm.

There are numerous specimens in the fine material from the deepest station, 9, in 50 fathoms and a single specimen from station 1. These have the characteristic aperture and form of the test figured by Brady, but the secondary divisions of the median portion are not well shown.

From the paucity of records this seems to be a very rare species, probably confined to the archipelagoes of the South Pacific, as the only record given by Brady is from 255 fathoms off Kandavu, Fiji.

Bolivina simpsoni Heron-Allen and Earland.

(Plate 4, Figures 1, 2.)

Bolivina simpsoni Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 648, pl. 49, figs. 18 to 35.

Test two or three times as long as broad, early portion rapidly tapering, later portion with the sides nearly parallel, periphery lobulate, rounded, the early portion with numerous stout spines radiating from the periphery, usually one from each chamber; chambers somewhat inflated; sutures dis-

tinct, depressed in the later portion, the earlier ones stoutly limbate and standing above the general surface; wall typically roughened and verriculate; aperture elongate, with the periphery somewhat lipped.

Length up to 1 mm.

The Samoan specimens are only from the deeper water station 9, in 50 fathoms. The specimens are not so verriculate as those figured by Heron-Allen and Earland, but the general characters are the same. They found it abundant in the dredgings from the Kerimba Archipelago, from off southeast Africa, and also record it from shore sand of Tamatave, Madagascar, also from Ngoney, Madagascar.

This adds another to the considerable list of species common to Samoa and the Kerimba Archipelago.

Bolivina tortuosa H. B. Brady.

(Plate 5, Figures 4, 5.)

Bolivina tortuosa H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 57; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 420, pl. 52, figs. 31 to 34.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 298, pl. 8, figs. 43, 44.—Millett, Journ. Roy. Micr. Soc., 1900, p. 543.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 187; 1902, p. 382.—Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 645.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 127.

Test short and broad, slightly longer than broad, much compressed, periphery acute but not carinate, the early chambers with their axis much twisted; chambers few, distinct, comparatively high, periphery not lobulate; sutures distinct, not depressed; wall with numerous coarse punctæ; aperture tending to become terminal, elongate, elliptical.

Length usually less than 0.3 mm.

The Samoan specimens are of the small, short, stout form which Brady figured from the Admiralty Islands. There are evidently two species included under this name. Specimens figured by Brady from the Cape Verde Islands are much larger, more tapering, with broader chambers, and the twisted character continued longer. Such specimens occur on the southern shores of the British Isles.

In the Indo-Pacific *Bolivina tortuosa* is known from the Polynesian Islands, from off Australia, Ceylon, and Mauritius.

The Samoan specimens are from station 9, in 50 fathoms.

Bolivina compacta Sidebottom.

(Plate 5, Figure 1.)

Bolivina robusta H. B. Brady, var. *compacta* Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 15, pl. 3, fig. 7.

Bolivina compacta Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 36, fig. 58 (in text); Carnegie Inst. Wash. Pub. 311, 1922, p. 26, pl. 1, fig. 10; Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 45.

Test elongate, tapering, periphery rounded, initial end bluntly pointed, apertural end obliquely rounded; chambers numerous, somewhat inflated; sutures very slightly depressed, not very distinct; wall ornamented by a series of large, coarse punctæ somewhat irregularly arranged, those of the last-formed chambers finer and more numerous; aperture elongate, extend-

ing from the base of the inner margin of the last-formed chamber to the highest point of the chamber; color white.

Length of Samoan specimens up to 0.55 mm.

Specimens were rare at stations 2 and 9.

The species seems to be widely distributed in tropical regions originally described from the Mediterranean and now known from the Gulf of Mexico and various localities in the tropical Pacific.

Bolivina mayori Cushman.

(Plate 6, Figures 3, 4.)

Bolivina mayori Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 27, pl. 3, figs. 5, 6.

Test elongate, somewhat compressed, of nearly uniform width, except in the extreme young, which rapidly broadens with the addition of the early chambers; chambers numerous, distinct; sutures depressed; wall thin, translucent, coarsely punctate, especially in the young, chambers in the later portion extending clear across the test, the last-formed chamber in the adult forming the entire width of the test and usually of less diameter than the preceding; the wall with longitudinal costæ, especially in the earlier portion, the later portion smooth but with numerous fairly coarse punctæ usually arranged in longitudinal lines; aperture in the adult terminal, elongate, extending nearly across the peripheral end of the last-formed chamber with a slightly projecting lip.

Length up to 0.75 mm.

Specimens referred to this species are common at station 9 in 50 fathoms and rare at stations 1 and 3.

This species seems to be the same as that described from the Tortugas region. A further study of the original figures of Hantken's *Bolivina nobilis* (Mittheil. Jahrb. ung. geol. Anstalt, vol. 4, 1875, pl. 15, figs. 4*a, b*) and a comparison of these with the figures referred to *B. nobilis* by Brady in the *Challanger* report (plate 53, figs. 14, 15) seems to indicate conclusively that the two are not identical. Brady's records are from the South Pacific and probably the species of the South Pacific and Tortugas regions are both *B. mayori.* Heron-Allen and Earland refer two forms from the Kerimba Archipelago to *B. nobilis* and as many species are common to the Samoan and Kerimba regions, one at least of their two forms may be *B. mayori.*

Bolivina limbata H. B. Brady, var. costulata Cushman.

(Plate 5, Figures 2, 3, 6.)

Bolivina limbata H. B. Brady, var. *costulata* Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 26, pl. 3, fig. 8; Bull. 104, U. S. Nat. Mus., pt. 3, 1924, p. 37.

Variety differing from the typical form of the species mainly in the addition of the longitudinal costæ, usually few in number and near the base of the test.

The later chambers tend to become uniserial and the aperture terminal as in the typical form, with a slightly developed lip. The test is usually somewhat twisted, a character which is found also in the typical form.

In shallow water in the Tortugas region from which the variety was originally described it is fairly common. In the Samoan collections it occurred at stations 1, 2, 3, 5, and 9.

The specimen from off Funafuti Atoll figured by Chapman (Journ. Linn. Soc. Zool., vol. 28, 1901, p. 409, plate 36, fig. 12) is an excellent example of var. *costulata* Cushman. The variety is probably widely distributed in the tropical Indo-Pacific, as it is figured also by Heron-Allen and Earland from the Kerimba Archipelago (Trans. Zool. Soc. London, vol. 20, 1915, p. 646, plate 50, figs. 1 to 4).

Bolivina vertebralis Cushman, new species.

(Plate 3, Figures 3, 4.)

Test very elongate, slender, tapering from the sub-acute initial end, the whole test twisted, in some adult specimens making a complete turn; chambers numerous, distinct, somewhat higher than broad in the adult; sutures depressed, the chamber often overhanging the suture at the base; wall thin, translucent, in the earliest chambers with indistinct longitudinal costæ, the later chambers smooth, punctate except near the lower portion which has numerous very short, fine spines; aperture in the adult somewhat terminal, elongate, curved, with a slight lip.

Length up to 0.75 mm.

Several specimens of this interesting species occurred at station 9 in 50 fathoms.

This species should be easily distinguished by its very slender, elongate form, distinct chambers, the peculiar twisted appearance, and the spinose ornamentation. It evidently belongs to the same group as *B. convallaria* Millett.

Bolivina sp.?

(Plate 4, Figure 3.)

A single incomplete specimen is here figured. In some respects it resembles *Bolivina pulchella* (d'Orbigny) of the West Indian region, but does not have the longitudinal costæ well developed. The surface is more of a granular one with irregularly placed papillæ.

The specimen is from the deepest locality, station 9, in 50 fathoms.

Genus BIFARINA Parker and Jones, 1872.

Bifarina Parker and Jones, Ann. Mag. Nat. Hist., vol. 10, 1872, p. 198.—Chapman, The Foraminifera, 1902, p. 173.

This genus includes those species which have their earlier chambers biserial as in *Bolivina,* but later become uniserial and the aperture instead of comma-shaped and connecting with the edge of the chamber becomes central and removed from the edge.

Bifarina mackinnonii Millett.

Bifarina Mackinnonii Millett, Journ. Roy. Micr. Soc., 1900, p. 281, pl. 2, fig. 15.—Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 643, pl. 48, figs. 36, 37.

"Test elongate, tapering toward the aboral extremity. Virguline chambers numerous and compressed into a cylindrical mass. Uniserial chambers

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triangular and much compressed, margins acute and carinate. Sutures limbate, forming a zigzag line. Aperture an elongated slit, terminal, and extending the full width of the chamber.

"Length 0.63 mm."

The above is the original description of Millett. He described it originally from the Malay Archipelago, Bawean Roads, between Java and Borneo, in 14 fathoms, very rare. The other records for it are given by Heron-Allen and Earland, who found it to be very rare in their Kerimba Archipelago collection from southeastern Africa, in shallow water, under 8 fathoms. They note that it "has a wide distribution in tropical waters. The best examples we have seen are from the late Capt. Seabrook's dredgings in the Macassar Straits (45 fathoms), but we have also met with occasional specimens in Vavau (Pacific) and other Pacific gatherings, and in shallow water at Ngoney, Madagascar."

This gives a rather typical Indo-Pacific distribution. The only Samoan specimen obtained from the collection was unfortunately lost. It was a large and well-developed specimen and showed the characteristic arrangement of the small knobs of the surface. It was from the deep-water station 9, in 50 fathoms, which seems to be the deepest record for the species. This is not far from Vavau in the Tonga group, where Heron-Allen and Earland record the species.

Genus VERNEUILINA d'Orbigny, 1840.

Verneuilina spinulosa Reuss.

Verneuilina spinulosa Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 384, pl. 47, figs. 1 to 3.—Cushman, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 60, pl. 19, fig. 4 (not fig. 5).

Test pyramidal, three-sided, triangular in transverse section, the sides flat or slightly concave, the initial end acutely pointed; initial end and angles of the chambers often with sharp, backwardly pointing spines; walls of medium thickness, hyaline, or in some cases thickened and rough, perforate, smooth or granular; apertural end of test bluntly angled, the edges of the chambers thickened; aperture a curved slit at the base of the inner edge of the chamber.

Length 0.25 to 0.60 mm.

This is one of the common species in the Samoan collections occurring at all but one of the stations and usually in considerable numbers. It is characteristic of shallow waters in tropical regions.

There is some amount of variation in the character of the surface and in the amount of spinosity.

Genus CHRYSALIDINA d'Orbigny, 1846.

Chrysalidina dimorpha H. B. Brady.

Chrysalidina dimorpha H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 54; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 388, pl. 46, figs. 20, 21.—Cushman, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 65, pl. 19, fig. 5 (not fig. 4).

Test elongate, tapering, triangular in cross section, the sides nearly equal, flat or somewhat carinate; early portion acute, consisting of chambers arranged triserially, the later portion of chambers in a single series; wall hyaline, perforate; apertures numerous, on the terminal face of the chamber.

Length about 0.50 mm.

The only specimen is from station 9, in 50 fathoms. It is a widely distributed species in the Indo-Pacific but is very rare in the western tropical Atlantic.

Genus GAUDRYINA d'Orbigny, 1839.

Gaudryina triangularis Cushman, var. angulata Cushman, new variety.

Variety differing from the typical in the later chambers which are very angular, the opposite sides parallel, giving a peculiar appearance to the test especially in end view.

Length of Samoan specimens up to 0.65 mm.

The short form with its spreading biserial portion consisting of very squarish chambers is peculiar. The early portion is triserial and triangular in section.

In their work on the collections from the Kerimba Archipelago, Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, p. 635) record *G. rugosa* with the following remark: "The specimens are all remarkable, owing to the fact that the terminal textularian chambers are practically square in section, the outer edges being parallel instead of curved." This description fits well the specimens from Samoa which are here described as var. *angulata*. As many of the species of the Kerimba and Samoan regions are common to the two areas their specimens are probably the same as ours.

The Samoan specimens are from stations 1, 5, and 9.

Genus CLAVULINA d'Orbigny, 1826.

Clavulina pacifica Cushman, new species.

(Plate 6, Figures 7 to 11.)

Clavulina angularis H. B. Brady (in part) (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 396, pl. 48, figs. 22–24.

Test elongate, early portion triserial, short, trihedral; later portion uniserial, the sides parallel or nearly so, triangular in transverse section, the sides flat or somewhat convex; chambers fairly high; sutures distinct, depressed, curved; wall arenaceous, but very smoothly finished, last-formed chamber tapering toward the apertural end, the whole rounded; aperture circular, with a fairly large tooth; color yellowish-brown.

Length up to 1.5 mm.

Type specimen from Samoa, station 1. It also occurred at stations 2, 3, 5, and at the outer edge of the Aua Reef. I have compared these specimens with those from the Tortugas region and other localities in the tropical western Atlantic, and the differences in the Atlantic and Pacific specimens are constant. *Clavulina tricarinata* from the Atlantic has sharper, more prominent angles to the test, the sides are usually distinctly concave, the apertural end is not so drawn out, the chambers are closer together, and the color grayish-white. *Clavulina pacifica* has the reverse of all these characters and a yellowish-brown color, and the test is even more smoothly finished than in *C. tricarinata.*

Brady evidently had this species, as he mentions in the *Challenger* report that *C. angularis* occurred "at numerous localities amongst the islands of the Eastern Archipelago, in shallow water, from 8 to 28 fathoms."

I have recorded *C. angularis* from the Philippines (Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 155, pl. 31, fig. 3), but a reexamination of the specimens seems to show at least two species present, included under the one name. One of these may be *C. pacifica.*

Heron-Allen and Earland record *C. angularis* from the Kerimba Archipelago, and it is to be suspected that they are *C. pacifica.* The species is probably widely distributed in the Indo-Pacific.

The development of the early stages is like that of *Verneuilina,* the aperture, as seen in figure 7, being connected with the edge of the chamber. This gradually closes and the aperture becomes central as in figures 8 and 9.

Clavulina difformis H. B. Brady.

(Plate 6, Figures 5, 6.)

Clavulina angularis d'Orbigny, var. *difformis* H. B. Brady, Rep. Voy. *Challenger,* Zoology, vol. 9, 1884, p. 396, pl. 48, figs. 25 to 31.—Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 637, pl. 48, figs. 20 to 22.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 156, pl. 31, figs. 2*a*, *b*.

Test elongate, somewhat tapering, usually polygonal, the sides concave, early triserial portion short, angles of the test sharp, slightly produced; chambers numerous, distinct, slightly inflated; sutures distinct, depressed, curved; wall arenaceous, rather roughly finished; aperture circular, with a distinct tooth, the last-formed chamber short and at the apertural end broadly truncate or even slightly depressed.

Length up to slightly more than 1 mm.

Specimens occurred at stations 1, 2, 3, 5, and 6 in the Samoan collections.

Brady's types came from Nares Harbor, Admiralty Islands. The form has hardly been recorded since. Heron-Allen and Earland record it from the Kerimba Archipelago off the southeast coast of Africa. I have recorded it from Apra Bay, Guam.

It can be easily distinguished from *C. pacifica* by its rough surface, the short, very truncate last-formed chamber, and the more concave sides.

Even where these two species occur together, as at Samoa, the two are very distinct and are easily separated.

Genus MIMOSINA Millett, 1900.

Mimosina Millett, Journ. Roy. Micr. Soc., 1900, p. 547.—Chapman, The Foraminifera, 1902, p. 174.

"Test typically spiral, conical or trochoid; chambers arranged bi- or triserially about the longitudinal axis. Aperture compound, consisting of two distinct orifices; one of them usually being a slit at the base of the inner wall of the final chamber; the other an opening varying in shape and situated near the apex of the chamber; the two orifices frequently being connected internally by means of a bent tube or septum. Shell-wall cellular or spongy."

The above is the original description of the genus as given by Millett who described 3 species from the Malay Archipelago. Heron-Allen and Earland have added 2 species from the Kerimba Archipelago, off southeastern Africa. Sidebottom had the genus from the Grecian Archipelago in the Eastern Mediterranean.

According to Heron-Allen and Earland (1915, p. 651), the "cellular or spongy" character of the wall of the test described by Millett "appears to be due to small vesicles in the thickness of the shell-substance communicating with the interior and exterior surfaces by the pseudopodial perforations."

The distribution of the species of the genus is interesting. They include the Malay region and the Indo-Pacific islands, west to the coast of Africa and apparently the Eastern Mediterranean. This is the common range for many species and genera of the Foraminifera.

Mimosina echinata Heron-Allen and Earland.

(Plate 7, Figure 1.)

Mimosina echinata Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 651, pl. 50, figs. 12–18.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 128.

Test with the early chambers triserial, later ones biserial; sutures largely obscured by the surface ornamentation, which is of a hispid character with a few larger spines; aperture double, one at the base of the last-formed chamber, the other also elongate, somewhat crescentiform and directly above.

Dimensions as given by Heron-Allen and Earland, "maximum breadth 0.10 to 0.14 mm., length 0.14 to 0.16 mm."

There is a single specimen of this species from station 9 in the Samoan collection. The specimen, although somewhat broken before figuring, is of the typical form and size.

Sidebottom records the species from off the east coast of Australia, in 465 fathoms.

Genus BULIMINELLA Cushman, 1911.

Buliminella elegantissma (d'Orbigny)?

There is a single specimen from station 9 in 50 fathoms which seems referable to this species. It is more inflated than usual and the apertural end is rounded, but with the single specimen it does not seem best to definitely place it until more material is obtained.

Buliminella elegantissima (d'Orbigny), var. apiculata Chapman.

Bulimina elegantissima d'Orbigny, var. *apiculata* Chapman, Journ. Linn. Soc., Zoology, vol. 30, 1907, p. 31, pl. 4, fig. 77; Subantarctic Islands of New Zealand, Wellington, 1909, p. 330; Zool. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 18.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 123, pl. 3, fig. 11.

Variety differing from the typical in having the initial end furnished with a stout spine.

Chapman originally described and figured this variety from Oligocene deposits of Australia. He later records it from off the Snares, New Zealand, as rare in 60 fathoms and still later from 40 miles south of Cape Wiles, South Australia, in 100 fathoms. Sidebottom records it from off the East coast of Australia, in 465 fathoms. In their account of the Foraminifera (British Antarctic (*"Terra Nova"*) Exped., Zool., vol. 6, no. 2, 1922, p. 129), Heron-Allen and Earland note the occurrence of a single specimen referable to this variety from 7 miles east of North Cape, New Zealand, in 70 fathoms.

In some respects this has a resemblance to *B. spinigera* Cushman from the western Atlantic, but a comparison of the two shows that they are very different in the arrangement of the chambers, general shape of the test, and the very smooth, shining wall of the Atlantic species.

Genus BULIMINOIDES Cushman, 1911.

Buliminoides williamsoniana (H. B. Brady).

(Plate 7, Figures 3, 4.)

Bulimina williamsoniana H. B. Brady, Quart. Jour. Micr. Sci., vol. 21, 1881, p. 56; Rep. Voy. *Challenger*, vol. 9, 1884, p. 408, pl. 51, figs. 16, 17.—Millett, Journ. Roy. Micr. Soc., 1900, p. 279, pl. 2, fig. 8.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 136.—Heron-Allen and Earland, Trans. Soc. Zool. London, vol. 20, 1915, p. 641; British Antarctic (*Terra Nova*) Exped., Zool., vol. 6, 1922, p. 130.

Buliminoides williamsoniana Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 90, fig. 144, (in text); Carnegie Inst. Wash. Pub. 311, 1922, p. 31, pl. 3, fig. 7; Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 113.

Test elongate, subcylindrical, composed of numerous chambers which are not distinct when viewed from the surface, the main ornamentation consisting of longitudinal costæ, usually somewhat spirally twisted, running from the initial end to the aperture; the aperture itself rounded, in the center of the oblique apertural face, the costæ of the surface running in to the center, making a radiate pattern about the aperture itself; color white.

Length of Samoan specimens up to 0.70 mm.

Specimens occurred only at station 9 in 50 fathoms.

The records for the species are mostly from the Indo-Pacific, with the exception of the Atlantic one from the Tortugas region. In the last of the references cited above I have given a summary of the distributional records, to which should be added the latest by Heron-Allen and Earland: "Spirits Bay, near North Cape, New Zealand, 11–20 fathoms" and "7 miles E. of North Cape, New Zealand, 70 fathoms." These same authors note that of their specimens "some show an absorbed final chamber which may indicate viviparity, not hitherto recorded in this species."

In this connection it may be noted that of the Samoan specimens but two showed the complete aperture as in figure 3. The others had the terminal face wanting and the chamber open, as in figure 4. This seems to be the common condition in large specimens and strongly suggests a development of young in the chamber and subsequent breaking down of the wall.

Genus VIRGULINA d'Orbigny, 1826.

Virgulina subsquammosa Egger.

There are 2 specimens from station 9, in 50 fathoms, which are nearest like the *Challenger* figures (plate 52, fig. 10). As I have previously noted, more than one species is included in this series given by Brady. Sidebottom mentions the occurrence of this species from off Eastern Australia, the specimens being similar to this same figure of Brady.

Genus CASSIDULINA d'Orbigny, 1826.

Cassidulina lævigata d'Orbigny.

A single specimen is probably this species. It is smaller than the usual run of Atlantic specimens and is very thin and hyaline.

Family LAGENIDÆ.

Genus LAGENA Walker and Jacobs, 1784.

Lagena bicarinata (Terquem), var.

(Plate 3, Figure 6.)

A single specimen from station 9, in 50 fathoms, seems to be a varietal form of this species. A figure of it is given.

Genus CRISTELLARIA Lamarck, 1812.

Cristellaria crepidula (Fichtel and Moll.)

(Plate 7, Figure 9.)

Nautilus crepidula Fichtel and Moll, Test. Micr., 1803, p. 107, pl. 19, figs. *g* to *i*.
Cristellaria crepidula d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat., Cuba, 1939, "Foraminiferes," p. 64, pl. 8, figs. 17, 18.

The specimen figured is a young one and there is also a more fully developed one from the same station, 9, in 50 fathoms. No specimens of the genus were found at any of the shallower stations.

Genus TRIFARINA Cushman, 1923.

Trifarina bradyi Cushman.

(Plate 7, Figure 5.)

Vaginulina tricarinata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 258, No. 4, Modeles, No. 4.
Rhabdogonium tricarinatum H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 525, pl. 67, figs. 1 to 3.
Triplasia tricarinata Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 62, pl. 39, fig. 2.
Trifarina bradyi Cushman, Bull. 104, U. S. Nat. Mus., pt. 4, 1923, p. 99, pl. 22, figs 3-9.

Test elongate, slightly tapering toward either end, often slightly twisted, greatest width above the middle, triangular in transverse section, angles carinate, chambers uniserial, usually distinct; sutures distinct, slightly depressed; wall usually thin and translucent, smooth, punctate; aperture terminal, central, rounded, usually with a slight neck and lip.

Length of Samoan specimens about 0.5 mm.

Specimens occurred only in material from the deepest station, 9, in 50 fathoms.

From the records the species has a very wide distribution and is found most abundantly at medium depths.

Genus UVIGERINA d'Orbigny, 1826.

Uvigerina porrecta H. B. Brady.

(Plate 7, Figures 6, 7.)

Uvigerina porrecta H. B. Brady, Quart. Journ. Micr. Sci., vol. 18, 1879, p. 60, pl. 8, figs. 15, 16; Rep. Voy. *Challenger*, vol. 9, 1884, p. 577, pl. 74, figs. 21 to 23.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 315, pl. 9, figs. 51, 63.—Millett, Journ. Roy. Micr. Soc., 1903, p. 269.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1910, p. 414.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 99, pl. 44, fig. 2.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 675.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 147.

Test much elongated, early chambers in a close spiral, later ones drawn out and considerably separated from one another, chambers, especially the later ones, concave below, the peripheral edge angular and projecting; upper surface of the chambers convex and ornamented by coarse longitudinal costæ which project slightly at the peripheral edge, making it serrate; aperture with an elongate tubular neck, the lip but slightly developed.

Length about 0.5 mm.

Specimens occurred at station 9 in 50 fathoms and a single specimen at station 1.

The distribution of this species seems to be limited to the Indo-Pacific. It is known from as far west as the Kerimba Archipelago, off southeastern Africa and from Mauritius, from the Malay Region, and from the South Pacific. Brady records it from off Bermuda, but I have failed to find it in any of the West Indian collections I have examined.

Heron-Allen and Earland speak of the Kerimba specimens as being all of a short, broad type, like Brady's figure 23. The specimens from Samoa, as will be seen by the figures, are of this same general form.

Uvigerina interrupta H. B. Brady.

(Plate 7, Figure 8.)

Uvigerina interrupta H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 8, figs. 17, 18; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 580, pl. 75, figs. 12 to 14. Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 313, pl. 9, fig. 58.—Chapman, Proc. Zool. Soc. London, 1895, p. 34.—Millett, Journ. Roy. Micr. Soc., 1903, p. 268.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151.—Chapman, Journ. Linn. Soc., Zoology, vol. 30, 1910.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 103, pl. 44, fig. 1.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 147.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 620.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 275.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, No. 2, 1922, p. 185.

Test slender, elongate, loosely spiral, chambers inflated, earlier ones in a more or less compact spire, later ones in an interrupted irregularly spiral series; surface with fine spines, giving a hispid character to the whole test; aperture with an elongated tubular neck and a phialine lip at its termination.

Length of Samoan specimens up to 0.65 mm.

Specimens were fairly common at station 9, but did not occur elsewhere. The species has a wide range in the general Indo-Pacific region. When well preserved the surface is delicately spinose and the whole test is thin and fragile.

Genus SIPHOGENERINA Schlumberger, 1883.

Siphogenerina raphanus (Parker and Jones).

(Plate 8, Figures 1, 2.)

Uvigerina (*Sagrina*) *raphanus* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 364, pl. 18, figs. 16, 17.

Sagrina raghanus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 585, pl. 75, figs. 21 to 24.

Siphogenerina (*Sagrina*) *raphanus* Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, fig. 36.

Siphogenerina raphanus Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 108, pl. 46, figs. 1 to 5; Carnegie Inst. Wash. Pub. 311, 1922, p. 35, pl. 5, fig. 5.

Test elongate, cylindrical, or tapering, chambers of the uniserial portion broader than long; surface marked by several rather widely separated, well-developed costæ, each extending nearly the length of the test and not affected by the sutures; aperture typically with a short tubular neck and well-developed flaring lip.

Length of Samoan specimens 1 mm.

Specimens were most abundant at station 9 in 50 fathoms, but also occurred at stations 1, 2, 5, 6, and 8.

The species is a characteristic one of the Indo-Pacific in comparatively shallow water. Both microspheric (plate 8, fig. 1) and megalospheric (plate 8, fig. 2) forms occur. As is usual, the microspheric form attains the largest size.

Siphogenerina virgula (H. B. Brady).

(Plate 8, Figures 3, 4.)

Sagrina virgula H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 275, pl. 8, figs. 19 to 21; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 583, pl. 76, figs. 4 to 7 (not 8 to 10).—Egger, Abh. kön. Bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 318, pl. 9, fig. 27?—Millett, Journ. Roy. Micr. Soc., 1903, p. 271.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 676, pl. 51, figs. 4, 5.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 148.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 186.

Test elongate composed of numerous inflated chambers, the early ones in a uvigerine arrangement, later ones uniserial, the uniserial portion making most of the test, surface hispid; aperture large, with a broad everted lip, the border of which often has a series of backwardly pointing long acicular spines.

Length of largest specimens up to 1 mm.

This species seems to be confined to the Indo-Pacific region, with a considerable range in depth, so far as the records show. In his original description of this species, Brady had more than one species, as a reference to the *Challenger* figures will show. One of the stations is in the South Atlantic, but this is probably not the same as the species of the Indo-Pacific.

All the records of the *Challenger* report except the one already noted are from the South Pacific, the range in depth given from 12 to 2,075 fathoms. Which of these is one and which the other species it is impossible to determine without seeing the originals. Heron-Allen and Earland had the species from the Kerimba Archipelago and from the *Terra Nova* collections. Sidebottom had it from off the coast of Australia. It was found in some numbers at stations 1, 2, 3, 6, and 9 in the Samoan collections.

Siphogenerina columellaris (H. B. Brady).

(Plate 8, Figures 5, 6.)

There are 2 specimens from station 9 in 50 fathoms which are probably this species. They are small and slender, and instead of being truly cylindrical are somewhat compressed. Both of these are figured, one being microspheric and attaining a much greater size than the more rounded megalospheric form.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA d'Orbigny, 1826.

Specimens of the various species of this genus are not common in the Samoan collections, although several species are represented in the material from the deepest station, 9, in 50 fathoms. The following species are represented:

Globigerina bulloides d'Orbigny.

Several specimens from station 9, a few from stations 1 and 6.

Globigerina bulloides d'Orbigny, var. triloba Reuss.

Rare at stations 3 and 5.

Globigerina æquilateralis H. B. Brady.

Rare at stations 6 and 8.

Globigerina conglobata H. B. Brady.

A single specimen from station 1 and a few from station 9.

Globigerina digitata H. B. Brady.

Rare specimens from station 9.

Globigerina rubra d'Orbigny.

Specimens were rare in material from stations 1 and 9. They do not show the complete characters either of form or color that are characteristic of typical Atlantic specimens.

Globigerina sacculifera H. B. Brady.

Rather typical specimens occurred in material from station 9.

Family ROTALIIDÆ.

Genus SPIRILLINA Ehrenberg, 1841.

Spirillina vivipara Ehrenberg.

(Plate 9, Figures 1, 2.)

Spirillina vivipara Ehrenberg, Abh. Akad. Wiss. Berlin, 1841, p. 442, pl. 3, fig. 41.—Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 37, pl. 5, fig. 7.

Test typically free, rarely adherent, planospiral, coils of early portion, in microspheric specimens at least, narrow, those of later coils much wider and nearly uniform in width, faces somewhat flattened, but more often concave on both sides; sutures distinct, often conspicuously depressed; periphery rounded; wall marked by conspicuous perforations, irregularly scattered, best developed on the last-formed volutions; aperture somewhat crescentic.

Diameter of Samoan specimens 0.35 to 0.45 mm.

Specimens occurred at stations 1, 2, 3, 5, and 9.

There is a considerable variation in the width of the chamber in the specimens if all these belong to one species. None of the Samoan specimens show the coarse perforations typical of Atlantic specimens, but are very finely and rather evenly punctate.

One very broad-chambered specimen is shown in plate 9, figure 1.

Spirillina limbata H. B. Brady.

Spirillina limbata H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 278, pl. 8, figs. 26*a*, *b;* Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 632, pl. 85, figs. 18 to 21.—Egger, Abh. Kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 395, pl. 18, figs. 43, 44.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 326, pl. 71, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1903, p. 694.—Chapman, Subantarctic Islands of New Zealand, Foraminifera, 1909, p. 353.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 5, pl. 2, figs. 1, 2 (fig. 5 in text).—Heron-Allen and Earland, Trans. Zool. Soc. London, 1915, p. 684.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 249.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 301.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 196.

Test planospiral, concave on both sides or merely flattened, composed of numerous coils of nearly uniform width; periphery truncate; wall smooth,

the sutural line marked by a raised ridge of calcaceous material, perforations fine and inconspicuous; aperture compressed.

Diameter of Samoan specimens not more than 0.45 mm.

Specimens were not common in the Samoan collections, occurring at the outer edge of the Aua Reef at Tutuila. The specimens are composed of fewer coils than in the typical as given by Brady, but this is probably true only of the megalospheric form.

Spirillina limbata H. B. Brady var. tuberculo-limbata Chapman.

(Plate 9, Figures 4, 5.)

Spirillina tuberculo-limbata Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1900, p. 11, pl. 1, figs. 8*a* to *c*.

Spirillina limbata H. B. Brady, var. *papillosa* Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 6, pl. 2, fig. 4.

Spirillina limbata H. B. Brady, var. *tuberculo-limbata* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 302.

Variety differing from the typical in having fewer and broader coils, the ventral side with numerous scattered papillæ and the coils obscured.

Specimens which seem referable to this variety occurred at stations 2 and 9 in the Samoan collections. One of the specimens figured here may be a microspheric form, the size being larger than the typical and the coils more numerous, the limbate character of the suture is less distinct but it is tuberculate.

Spirillina inæqualis H. B. Brady.

(Plate 8, Figures 7, 8.)

Spirillina inæqualis H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 278, pl. 8, figs. 25*a*, *b*; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 631, pl. 85, figs. 8 to 11.—Egger, Abh. Kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 394, pl. 18, figs. 40 to 42.—Millett, Journ. Roy. Micr. Soc., 1903, p. 693.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 34, pl. 2, fig. 12.—Chapman, Subantarctic Islands of New Zealand, 1909, p. 353.—Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 282.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 6, pl. 3, fig. 3; fig. 6 (in text).—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 684; British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 196.

Test rather thick with the coil nearly uniform in width, periphery obliquely truncate, flattened, broad side of the test with numerous tubercules in a single line, opposite side narrower, somewhat concave without definite ornamentation; aperture broad and low.

Diameter of Samoan specimens up to 0.5 mm.

The only specimens in the Samoan collections are from station 1.

This species originally described by Brady has a typical Indo-Pacific range. Brady's *Challenger* records are as follows: "Off Honolulu, Sandwich Islands, 40 fathoms; Nares Harbour, Admiralty Islands, 17 fathoms; off Tongatabu, Friendly Islands, 18 fathoms; off Fiji Islands, 12 fathoms; and off Raine Island, Torres Strait, 155 fathoms." There are numerous other records for this species, all in this same general area, extending from the Kerimba Archipelago in the west through Ceylon to Funafuti and Hawaii, and southward to Australia.

Spirillina spinigera Chapman.

(Plate 9, Figures 6, 7.)

Spirillina spinigera Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1900, p. 10, pl. 1, figs. 7*a* to *c;* vol. 28, 1901, p. 188, pl. 19, figs. 9, 10; Subantarctic Islands of New Zealand, 1909, p. 353.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 251.

Spirillina decorata H. B. Brady, Mem. Proc. Manchester Lit. Philos. Soc., vol. 52, pt. 5, 1908, p. 8, pl. 2, fig. 6.

Test plano-convex, basal face flattened or concave, upper face convex; wall somewhat ornamented along the suture line; periphery with a slight keel which is serrate or with numerous spines.

Diameter 0.25 to 0.30 mm.

Specimens occurred rarely at station 9 in 50 fathoms.

The species seems to be a rare one and is known from but a few records in the Australian region. Chapman described it originally from beach sand at Avalau Island (South Island), Funafuti, very rare and from the boring in the lagoon at Funafuti at 62 feet below the floor of the lagoon, also very rare. He later records it from the lagoon at Funafuti in 7.5 fathoms. Sidebottom records it from *Challenger* station 185 off Raine Island, Torres Strait, and from the Mediterranian off the island of Delos, a single specimen. Chapman later records a single specimen from northeast of Bounty Island, off New Zealand, in 50 fathoms.

Chapman had both microspheric and megalospheric specimens from the lagoon at Funafuti, the former of larger size, with a thinner border and serrate rather than spinose, the latter smaller and the periphery decidedly spinose.

Spirillina sp.?

(Plate 9, Figure 3.)

From station 9 in 50 fathoms is a specimen of a species of *Spirillina* which is here figured. There are no other specimens to check this, and I have therefore not specifically determined it.

Genus PATELLINA Williamson, 1858.

Patellina advena Cushman.

Patellina advena Cushman, U. S. Geol. Survey, Prof. Paper 129–F, 1922, p. 135, pl. 31, fig. 9.

Test plano-convex, early portion composed of chambers spirally arranged, later ones elongate and becoming nearly annular; chambers partly divided by numerous longitudinal internal septa, visible from the exterior, forming what seems to be a radiating pattern; ventral side with numerous radiating lines.

Diameter up to 0.5 mm.

Typically this form is scale-like and low, the walls very thin. It differs from the species of the colder Atlantic region in the much finer divisions of the chambers and the tendency of the last-formed chambers to become nearly annular. This latter tendency reaches its greatest development in var. *annularis* (Parker and Jones). It is

common in the shore sands of South Australia, according to Heron-Allen and Earland (British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 198).

The species is common in the deeper water station Pago Pago Harbor, Samoa, in 50 fathoms, at station 9.

There are numerous records for *P. corrugata* Williamson in the Pacific and it is very probable that they all represent *P. advena*. It is another of the examples where the Oligocene of the Coastal Plain of the United States is closely allied to the living fauna of the South Pacific.

Heron-Allen and Earland (l. c.) note a very interesting specimen of this species where the under side of the test was resorbed and the space thus made occupied by numbers of young specimens.

Genus DISCORBIS Lamarck, 1804.

Discorbis subbertheloti Cushman, new species.

(Plate 10, Figure 1.)

Discorbina bertheloti H. B. Brady (in part) (not d'Orbigny) Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 650, pl. 89, figs. 10*a* to *b*.

Test attached, plano-convex, composed of about 2½ coils, 4 to 5 chambers in each coil; chambers distinct, slightly keeled on the flattened side of the test, not on the convex side; wall thin, very finely punctate; aperture a curved slit at the ventral margin of the last-formed chamber.

Diameter about 4.5 mm.

Type specimen from Samoa, station 5.

This species differs much from *D. bertheloti* (d'Orbigny) as figured in the Canaries paper. That species as figured has 7 chambers in the coil, is not so rounded, and is decidedly keeled. I do not know the locality for the specimen of Brady's quoted above but figure 12 of the same plate is from *Challenger* station 6 in the North Atlantic. Brady had specimens from the South Pacific and Australian regions, and it is to be suspected that plate 89, figure 10, may have been drawn from a species from this general region.

Discorbis patelliformis H. B. Brady.

Discorbina patelliformis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 647, pl. 88, figs. 3*a* to *c;* pl. 89, figs. 1*a* to *c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 17, pl. 5, fig. 5, figs. 19*a* to c (in text).—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 703, pl. 52, fig. 32.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 254.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 204.

Test conical, ventral side flattened, 5 or 6 chambers in the last-formed coil; sutures limbate, not depressed, surface of dorsal side smooth, ventral side marked with a series of radial ribs or beaded lines; aperture a narrow slit at the ventral side of the last-formed chamber.

Diameter of largest Samoan specimen 0.4 mm.

The only Samoan specimens are from the outer edge of the Aua Reef, Tutuila, and stations 2 and 5.

The species is confined to the Indo-Pacific if we except the record of Egger from the Atlantic off the Cape Verde Islands and that of Brady from Malta.

In the North Pacific it is recorded only from Laysan Island (Rhumbler). Brady records it from Ceylon, Madagascar, and Mauritius and "as not uncommon amongst the islands of the Pacific, at depths of 6 to 150 fathoms." Plate 89, figure 1, of the *Challenger* Report is from station 187 in 6 fathoms, Torres Strait. Chapman records it as very rare outside the Funafuti Reef in 35 and 36 fathoms. Dakin records it as rare in the Gulf of Manaar; Heron-Allen and Earland as common and widely distributed in the Kerimba Archipelago; Egger from Mauritius and Western Australia; Mestayer from off New Zealand in 98 fathoms, whence I have also had it; Millett from the Malay Archipelago; Sidebottom from the east coast of Australia in 465 fathoms, small specimens; Heron-Allen and Earland as rare in the *Terra Nova* material from the Antarctic, and by Chapman as rare off New Zealand, 20 miles north of Auckland Islands and 10 miles north of Enderby Island, both in 85 fathoms. This gives a very general Indo-Pacific distribution.

Specimens which seem specifically identical with this were obtained from the Lower Oligocene, Byram marl, and Mint Spring marl of Mississippi (Cushman, U. S. Geol. Surv. Prof. Paper 133, p. 38, pl. 6, figs. 2 to 4). This again links the Oligocene of the Mississippi Embayment with the living fauna of the Indo-Pacific.

Genus CYMBALOPORA Hagenow, 1850.

Cymbalopora bradyi Cushman.

(Plate 10, Figures 2 to 4.)

Cymbalopora poeyi, var., H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 637, pl. 102, fig. 14.

Cymbalopora poeyi (d'Orbigny), var. *bradyi* Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915 p. 25, pl. 10, fig. 2; pl. 14, fig. 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 308.

Test with the chambers in a very flattened, irregular spire, numerous, as many as 10 appearing on the ventral side, where those of the last-formed coil are visible; wall rather coarsely perforate, the sutures distinct and slightly depressed.

Diameter of Samoan specimens up to 0.9 mm.

Specimens occurred at stations 1, 2, 4, 5, and 9, as well as on the outer edge of the Aua Reef at Tutuila.

No specimens of the conical *C. squammosa* d'Orbigny occurred in the material. This form, originally figured by Brady as a variety without name, it now seems should be raised to specific rank. The original figured specimen of the variety in the *Challenger* report is from station 217 A, Humboldt Bay, New Guinea, in 37 fathoms. Brady mentions the fact that this form is often much more abundant than the conical one.

This species is apparently widely distributed in the Indo-Pacific and at least at Samoa seems to occur to the exclusion of the conical species.

Cymbalopora tabellæformis H. B. Brady.

(Plate 10, Figures 5 to 7.)

Cymbalopora tabellæformis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 637, pl. 102, figs. 15–18.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 382, pl. 18, figs. 54, 55.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 189.—Millett, Journ. Roy. Micr. Soc., 1904, p. 697.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 25.—Heron-Allen and Earland, Trans. Zool. Soc. London vol. 20, 1915, p. 688.

Test oval or circular, flattened, the chambers numerous, often twelve or more in the last-formed coil, periphery slightly lobulate; wall coarsely perforate; aperture umbilical with numerous secondary pores along the ventral sides of the chambers.

Diameter of largest Samoan specimen 0.85 mm.

Specimens are rare, occurring at stations 5, 8, and 9.

Brady originally recorded this species as follows:

"The finest specimens hitherto obtained have been from shore-sands collected at Tamatavé, on the east coast of Madagascar, and it has also been found in harbour-mud from Port Louis, Mauritius. It is common in the neighborhood of the Fiji Islands, at various depths from 12 fathoms to 610 fathoms, and has been noticed in dredged sands from the Ki Islands, 129 fathoms, the Philippine Islands, 95 fathoms, and the Sandwich Islands, 40 fathoms."

Of Brady's figured specimens, figure 17 is from *Challenger* station 209 in the Philippines and figure 18 from station 174 c, 210 fathoms, off Kandavu, Fiji. I do not know from what stations the originals of figures 15 and 16 came.

Egger's record is from Mauritius. Millett had specimens from 4 stations in the Malay Archipelago. I had specimens from one *Nero* station, 2071, in 271 fathoms, off the Hawaiian Islands. Chapman has numerous records from around Funafuti, from the lagoon and from the ocean beaches as well as from stations outside the reef. The only station from which he records it as common is outside the reef at Tutanga, in 200 fathoms. Heron-Allen and Earland record it as generally distributed in the Kerimba Archipelago. Its record seems to make it a species limited to the Indo-Pacific and to warm waters in the region of coral reefs. Heron-Allen and Earland give some very interesting notes of its occurrence and habits (Phil. Trans. Roy. Soc., vol. 206, 1915, p. 258, pl. 18, fig. 53).

Genus TRETOMPHALUS Moebius, 1880.

Tretomphalus bulloides (d'Orbigny).

(Plate 11, Figures 1 to 3.)

Rosalina bulloides d'Orbigny,in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiferes," p. 104, pl. 3, figs. 2 to 5.

Cymbalopora bulloides Carpenter, Parker and Jones, Introd. Foram., 1862, p. 216.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 638, pl. 102, figs. 7 to 12, text figs. 20*a* to *c*.

Tretomphalus bulloides Moebius, Beitr. Meeresfauna Insel Mauritius, 1880, p. 98, pl. 10, figs. 6 to 9.—Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 42, text-figs. 2, 3.

Test free, subglobular, early chambers rotaliform, numerous, rather coarsely perforate, forming a cap to which it attached a large final "balloon-chamber," subspherical, with coarse perforations on the ventral side, and within a "float-chamber" with a single opening at the base, from which a tubular neck projects inward; color of the early chambers dark brown, the large chamber colorless.

Diameter of the Samoan specimens not over 0.45 mm.

Specimens occurred at station 9.

Certain of the specimens from station 9, while not typical entirely, may provisionally be referred to *T. bulloides*. The "balloon-chamber" is generally spherical and the smaller chambers extend well down over the sides.

With these at station 9 and also occurring at stations 2 and 5 are specimens of another form in which the earlier chambers form a very much flattened cap and the whole "balloon-chamber" is much wider than high. This is evidently a distinct form and may be known as *T. bulloides* (d'Orbigny), var. *plana* Cushman, new variety (plate 10, fig. 8).

Tretomphalus milletti (Heron-Allen and Earland).

(Plate 11, Figure 4.)

Cymbalopora bulloides Millett (not d'Orbigny), Journ. Roy. Micr. Soc., 1903, p. 697, pl. 7, fig. 4.

Cymbalopora milletti Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 689, pl. 51, figs. 32 to 35.

Early chambers forming a high spire, the earliest forming a distinct spire, later ones acervuline, "balloon-chamber" longer than broad, with a longitudinally wrinkled appearance due to the attachment of the "float-chamber" to the outer wall; openings at the lower end of the "balloon-chamber" few and somewhat indistinct.

Diameter of Samoan specimens not over 0.3 mm.

Specimens occurred only at the deep station 9, in 50 fathoms.

Heron-Allen and Earland described this species from the Kerimba Archipelago, off Southeastern Africa. It occurred at 15 stations there. Millett had it from the Malay Archipelago. The authors give the following statement: "The distribution of *C. milletti* certainly extends all over the tropical Indo-Pacific area, but we have not met with it as yet in the tropical Atlantic." They also note that there

are specimens in the Brady collection from Levuka, Fiji, and note the resemblance of *Challenger* plate 102, figure 9 to this species. The original of that figure is from *Challenger* station 260A, 40 fathoms, off Honolulu, Hawaiian Islands.

There are certain specimens in the Samoan collection with "balloon-chambers" but *Discorbis*-like young which are probably new species, but they have been left to a fuller study with more material for comparison.

Genus PLANORBULINA d'Orbigny, 1826.

Planorbulina larvata Parker and Jones.

(Plate 11, Figure 5.)

Planorbulina vulgaris d'Orbigny, var. *larvata* Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 294.

Planorbulina larvata Parker and Jones, Philos. Trans., vol. 155, 1865, p. 379, pl. 19, figs. 3*a*, *b*.—Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 19, 1877, p. 214, pl. 13, fig. 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 658, pl. 92, figs. 5, 6.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 381, pl. 14, fig. 31.—Chapman, Proc. Zool. Soc. London, 1895, p. 40; Journ. Linn. Soc. Zool., vol. 28, 1900, p. 193.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 27, pl. 8, fig. 2.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 706.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 310; U. S. Geol. Surv., Prof. Paper 133, 1923, p. 39, pl. 6, figs. 7, 8.

Test typically attached, discoidal; chambers of the central portion hidden by the development of thick granules or tubercles on the test making the sutures indistinct; peripheral chambers arranged in annular rings, distinct; sutures somewhat depressed; apertures lipped.

Diameter of Samoan specimens up to 1 mm.

Specimens were rare at stations 5 and 9.

This is a tropical species well distributed in the Indo-Pacific, most abundant in comparatively shallow water. It is very common in the Philippines on the coral reefs, and Chapman found it common at Funafuti. It occurs in the Lower Oligocene of the Mississippi Embayment of the United States.

Planorbulina acervalis H. B. Brady.

Planorbulina acervalis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 657, pl. 92, fig. 4.—Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 45, pl. 6, fig. 3.

Test typically adherent, composed of numerous chambers, early ones spiral, later ones irregularly annular, those of the periphery lobulated, the newly added chambers extending outward a considerable distance beyond the preceding ones; ventral surface often covered by a mass of small acervuline chambers; wall conspicuously porous; apertures lipped.

Diameter of Samoan specimen 0.75 mm.

There is but a single specimen of this species from station 2.

This is essentially a species of shallow warm waters occurring well distributed in the Indo-Pacific and also apparently in the Gulf of Mexico.

Genus TRUNCATULINA d'Orbigny, 1826.

Truncatulina rostrata H. B. Brady.

(Plate 11, Figures 6, 7.)

Truncatulina rostrata H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 65; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 668, pl. 94, figs. 6*a* to *c*.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 194.—Dakin, Rept. Pearl Oyster Fisheries Ceylon, 1906, p. 238.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1028.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 709, pl. 52, figs. 33 to 36.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 321.

Test bilaterally symmetrical, involute, last-formed coil consisting of about 10 chambers, periphery keeled, wall very coarsely perforate or pitted; sutures limbate; aperture a very narrow slit at or slightly to one side of the periphery with another at the base of the apertural face.

Diameter of largest Samoan specimens 0.85 mm.

This rare species has proved to be a common species in the Samoan collections, occurring at stations 1, 2, 3, 4, 5, 6, 8, 9 and at the outer edge of the Aua Reef, Tutuila, often in considerable numbers. The previous records for the species are very few.

Brady's records are Humboldt Bay, New Guinea, 37 fathoms, and near the Admiralty Islands, 16 to 25 fathoms, as well as off Tongatabu, Friendly Islands, 18 fathoms. Chapman records it from the Lagoon at Funafuti 7.5 to 23 fathoms; Dakin from the Gulf of Manaar; Pearcey from 56 fathoms, Burdwood Bank; Heron-Allen and Earland at one station in the Kerimba Archipelago in very shallow water of the reefs, and I have had it from a single station in the Philippines in 20 fathoms.

This is such a striking species that it would not easily be overlooked, and therefore it must be rather limited in its distribution from the few records.

It is not a typical *Truncatulina,* and, as Brady remarks, is most closely allied in its apertural characters with *Pulvinulina elegans.*

Truncatulina tubulifera Heron-Allen and Earland.

(Plate 11, Figure 8.)

Truncatulina tubulifera Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 710, pl. 52, figs. 37 to 40.

Test free, biconvex, consisting of two or three coils all visible on the dorsal side, only those of the last-formed coil on the ventral side, six to seven chambers in the last-formed coil; sutures thickened but not raised; wall coarsely perforate, the sides often produced into a tube, especially on the dorsal surface, coalescing near the periphery; aperture a curved slit on the inner edge of the last-formed chamber.

Diameter of Samoan specimens 0.4 mm.

The only specimens are from stations 2 and 3.

Heron-Allen and Earland give several stations for this species, all in the Indo-Pacific, as follows: Mascassar Straits, 45 fathoms; *Challenger* station 185, Raine Island, Torres Straits, 155 fathoms; Vavau, in the Friendly Islands, 16 fathoms; and from 4 stations in the Kerimba Archipelago.

It may be noted here that a species I have described from the Lower Oligocene, Byram marl, of Mississippi, as *Pulvinulina advena* Cushman is closely allied to this Indo-Pacific species (U. S. Geol. Surv., Prof. Paper 129, 1922, p. 99, pl. 22, fig. 8).

Truncatulina mayori Cushman, new species.

(Plate 12, Figures 3, 4.)

Test scale-like, much compressed, slightly plano-convex, last-formed coil of 5 chambers, in the adult the inner angle with a reentrant that is not filled in by the succeeding chamber, thereby leaving a perforation through the test; periphery keeled, the thin keel often incised; sutures broad but not raised, surface of the walls very coarsely perforate, tending to become tubular; aperture a narrow curved slit at the base of the last-formed chamber.

Diameter of largest Samoan specimen 0.9 mm.

Type specimen from station 2. The species also occurs at stations 1 and 5.

In some respects this resembles the figures given by Brady and referred by him to *T. refulgens* (Montfort), but the Samoan species is very thin and scale-like and has the peculiar perforate character already noted. It is named in honor of the late Alfred G. Mayor.

Truncatulina haidingeri (d'Orbigny), var. pacifica Cushman, new variety.

(Plate 12, Figures 1, 2.)

Variety differing from the typical in the lower spire, the acute periphery, and the apertural lip, which extends to the upper side.

Diameter of Samoan specimens up to 0.75 mm.

Type specimens from station 9, in 50 fathoms. Specimens have been common in the collections, occurring at stations 1, 2, 3, 4, and 5.

This is the same form as that I have figured from the Philippines (Bull. 100, U. S. Nat. Mus., vol. 4, 1920, p. 315, pl. 64, figs. 3*a* to *c*).

Genus ANOMALINA d'Orbigny, 1826.

Anomalina glabrata Cushman, new species.

(Plate 12, Figures 5 to 7.)

Test free, biconvex, compressed, periphery broadly rounded, all chambers visible from the dorsal side, only those of the last-formed coil from the ventral side, which is umbilicate; 8 or 9 chambers in the last-formed coil; wall very smooth and polished, very finely punctate; sutures very distinct, but only very slightly depressed; aperture a curved opening at the base near the periphery and ventral angle of the last-formed chamber.

Diameter of Samoan specimens about 0.4 mm.

Type specimens from station 1, others from stations 2, 6, and 9, most common at the last station.

This seems to be a distinctive species resembling in general the group of *Anomalina grosserugosa* (Gümbel), but with its small size, finely punctate walls, and polished surface very different from others of the group.

Genus SIPHONINA Reuss, 1849.

Siphonina echinata (H. B. Brady).

(Plate 12, Figure 8.)

Planorbulina echinata H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 283, pl. 8, fig. 31.
Truncatulina echinata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 670, pl. 94, figs. 9 to 14.—Millett, Journ. Roy. Micr. Soc., 1904, p. 490.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 42, pl. 18, figs. 1 to 4.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 711, pl. 53, fig. 1.

Test nearly spherical, composed of about 2 irregular coils, the last-formed one of about 4 chambers; wall coarsely punctate, thick, smooth except for a few blunt spinose projections; aperture a short tube with a circular opening and slight lip.

Diameter of Samoan specimen about 0.4 mm.

The only specimen is from the outer edge of the Aua Reef, Tutuila.

This is evidently a rare species occurring in the Indo-Pacific in comparatively shallow water. Brady's records are as follows: "Off Calpentyn, Ceylon, 2 fathoms; the Harbour of St. Louis, Mauritius, and the shore at Tamatavé, Madagascar; off Honolulu Reefs, 40 fathoms," with 10 others among the islands of the South Pacific, 2 to 155 fathoms. Of Brady's figured specimens, plate 96, figure 9 is from *Challenger* station 185, in 155 fathoms, Torres Strait; figures 10, 13 and 14 from station 260 A, 40 fathoms, off the Coral reefs of Honolulu. Millett had it from several stations in the Malay Archipelago. Goddard records it from 80 fathoms, east of Sydney. Heron-Allen and Earland record it from all but one of their stations in the Kerimba Archipelago.

Egger's figures as noted by Heron-Allen and Earland do not represent this species. I suspect they belong to the following, but the figures are too lacking in details to make certain.

Siphonina tubulosa Cushman, new species.

(Plate 13, Figures 1, 2.)

Test free, compressed, keeled, the last-formed coil consisting of three or four chambers; sutures slightly depressed; wall with numerous short tubular projections and the periphery with a border of longer projections of the same type; aperture with a compressed short tubular neck and widely flaring lip.

Diameter of Samoan specimens up to 0.5 mm. usually less.

Type specimens from station 9 in 50 fathoms.

This species has been confused with *S. reticulata* (Czjzek) and *S. fimbriata* (Reuss), but is distinct from either. Even in the young stages it has the tubular projections of the surface which become more prominent with age. Some of Brady's figures under *Truncatulina reticulata* Czjzek resemble this in some ways, but do not show the spinose projections. Brady has 2 species on his plate 96 under this name. Figure 8 of that plate is from *Challenger* station 24 off Culebra Island, West Indies, and represents *Siphonina pulchra* Cushman.

Genus PULVINULINA Parker and Jones, 1862.

Pulvinulina peroblonga Cushman, new species.

(Plate 13, Figures 3 to 5.)

Test free, much elongate, sides nearly parallel, periphery acute, about 8 chambers in the last-formed coil, rapidly increasing in length as added; sutures distinct, not depressed; wall smooth, very finely punctate, a clear area near the base of the chamber on the ventral side; aperture an arched slit on the ventral side at the base of the last-formed chamber.

Length of Samoan specimens up to 0.6 mm.

Type specimen and others from station 9.

This species is distinctive in its oblong shape, and in the series of specimens from this station is very uniform in character. It belongs to the group of *P. oblonga* and *P. auricula,* but is different from either. It will be interesting to know what its wider distribution in the Indo-Pacific may be.

Pulvinulina mayori Cushman, new species.

(Plate 13, Figure 6.)

Bulimina convoluta Millett (not Williamson), Journ. Roy. Micr. Soc., 1900, p. 279, pl. 2, fig. 9.

Test free, elongate, much compressed, periphery rounded, chambers rapidly increasing in length as added, the inner portion more or less definitely divided with a secondary chamber; wall thin and translucent, very finely punctate, with a clear area near the ventral border; aperture a curved arched opening at the base of the larger chamber.

Length of Samoan specimen 0.35 mm.

Type specimen from station 1, another from station 2.

A close study of these two specimens has convinced me that this South Pacific species is in reality a *Pulvinulina.* In the type specimen there is no sign of the secondary chambers on the dorsal side, while in the other they are very slight.

Millett's notes are as follows:

"This admittedly abnormal form, although classed with the *Textulariidæ,* does not possess the true Textularian plan of growth, inasmuch as the chambers do not alternate in the sense that each successive addition shifts the aperture from one side of the test to the other. The plan of growth is rather Rotaliform; a primary row of chambers having applied to it a secondary row analogous to the 'asterigerine' flaps found in the genus *Discorbina.*"

A study of the Samoan specimens confirms this last and seems definitely to show that these are secondarily divided chambers and not in any sense an alternating series and that the aperture is really in the larger chamber at the junction with the smaller part. The clear space at the ventral side of the last-formed chamber is similar to that seen in *Pulvinulina oblonga, P. peroblonga, P. indica, P. philippinensis,* and others of this group.

On the other hand, the specimens figured by Williamson apparently represent a definite Atlantic species of *Buliminoides,* and the resemblance between the two is superficial only.

Brady's figure of a specimen from Torres Straits (plate 113, fig. 6) is evidently the same. His note under *P. oblonga* (p. 688), "the septal face of the final segment is inflated, and the inner margin is generally extended so as to form a sort of flap, which overlaps and conceals the inferior umbilical ends of the earlier segments," seems to show a stage in the general evolution of such a species as *P. mayori*.

Other Indo-Pacific records which are probably this species are Sidebottom (Journ. Roy. Micr. Soc., 1918, p. 124) from off the east coast of Australia; Egger (Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 288, pl. 8, figs. 83, 84) from Mauritius and West Australia at least; Chapman lists it from 50 to 200 fathoms off Funafuti; Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, p. 641) from the Kerimba Archipelago. The last-named authors have recognized the difference in the Pacific species in their Antarctic paper (British Antarctic Exped., Zoology, vol. 6, 1922, p. 130) where under *B. convoluta* is this note: "A single specimen of Williamson's original type, not Millett's Malay type."

Our species of *Pulvinulina* is probably widely distributed in the Indo-Pacific.

Pulvinulina favus H. B. Brady?

(Plate 13, Figures 7, 8.)

Pulvinulina favus, H. B. Brady, Geol. Mag. dec. 2, vol. 4, 1877, p. 294; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 701, pl. 104, figs. 12 to 16.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 417, pl. 18, figs. 13 to 15.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 65.

Test free, rotaliform, composed of few chambers, the surface covered with a reticulate network obscuring the structure of the test.

Diameter of Samoan specimen 0.3 mm.

A single specimen from station 2.

The records for this species are mostly from the Indo-Pacific, in deep water. It is therefore unexpected to find a specimen from such a shallow depth. Egger's figures show a more regular form of test than Brady's *Challenger* figures. This Samoan specimen may represent some other species of shallow water, the single specimen not showing the full characters.

Pulvinulina repanda (Fichtel and Moll.)

(Plate 13, Figures 9, 10.)

Nautilus repandus Fichtel and Moll, Test. Micr., 1798, p. 35, pl. 3, figs. *a* to *d*.

Rotalia repanda Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 175, No. 25.

Pulvinulina repanda Parker and Jones, in Carpenter, Parker and Jones, Introd. Foram., 1862, p. 311.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 684, pl. 104, figs. 18*a* to *c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 50, pl. 24, fig. 3.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 713.—Chapman, Biol. Results *Endeavour*, vol. 3, pt. 1, 1915, p. 32.—Cushman, Bull. 676, U. S. Geol. Surv., 1918, p. 66, pl. 23, fig. 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 326; Carnegie Inst. Wash. Pub. 311, 1922, p. 51, pl. 8, figs, 10 to 12.—Heron-Allen and Earland, British Antarctic Exped., Zoology, vol. 6., 1922, p. 213.

Test almost equally biconvex; peripheral margin acute, slightly lobulated, carinate; chambers 7 or 8 in the last-formed whorl; sutures somewhat curved above, nearly radial below, limbate on both surfaces, on the ventral side running into one another and merging at the umbilical area; wall smooth, finely punctate; aperture a slightly arched opening halfway between the umbilicus and the peripheral margin.

Diameter of Samoan specimens up to 1 mm.

Specimens occurred sparingly at stations 2, 3, and 5.

This is a widely distributed species especially common in tropical and subtropical waters in the vicinity of coral reefs.

Genus ROTALIA Lamarck, 1804.

Rotalia soldanii d'Orbigny?

(Plate 14, Figure 3.)

There is a single specimen of a very smooth *Rotalia* which is figured here. It occurred at station 4. It is much higher than the usual deep-water form of *R. soldanii* and may prove to be a different species.

Rotalia venusta H. B. Brady.

(Plate 14, Figures 1, 2.)

Rotalia venusta H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 708, pl. 108, fig. 2.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 422, pl. 19, figs. 13 to 15.—Millett, Journ. Roy. Micr. Soc., 1904, p. 506.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 720, pl. 53, figs. 15 to 22.

Test somewhat compressed but variable, ventral face usually the more convex, margin often somewhat angular, usually slightly lobulated, about 8 chambers in the last-formed whorl; sutures somewhat limbate above, slightly depressed below, dorsal surface slightly, ventral face strongly, rugose; aperture on the ventral face at an agle to the preceding whorl, widest at the outer end.

Diameter of Samoan specimens 0.6 mm.

The only specimens are from outer edge of Aua Reef, Tutuila.

Brady's original records are from the South Pacific, four *Challenger* stations amongst the islands south of New Guinea in 3 to 7 fathoms; one off the west coast of Chile in 345 fathoms. His best material was from off Calpentyn, Ceylon, in about 2 fathoms. Egger's station was off the Cape of Good Hope in 37 fathoms. Millett had it from the Malay Archipelago, and Heron-Allen and Earland found it to be one of the most abundant species in the dredgings from the Kerimba Archipelago. It is therefore a species of warm, shallow waters of the Indo-Pacific.

Rotalia murrayi Heron-Allen and Earland.

Rotalia murrayi Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 721, pl. 53, figs. 27–34.

"Test free, subglobular, consisting of three to four convolutions each of about six inflated chambers. Sutural lines depressed. The whole surface

of the shell covered with secondary growth in the form of short blunt spines which mark the outlines of the chambers. These processes are more numerous on the superior than on the inferior surface. The umbilical recess of the shell is filled with a dense growth of separate spines. Aperture obscure, but apparently a slit on the inner margin of the final chamber, hidden by secondary growths."

Diameter of Samoan specimen about 0.3 mm.

A single specimen from station 3.

The above description is from Heron-Allen and Earland. Our specimen is most like their plate 53, figures 29 and 30.

Besides recording the species from 6 stations in the Kerimba Archipelago, the authors had it also from shore sand from Sandoway, Arakan Coast, Burma, and from shallow water at Segaar, New Guinea. Our Samoan record extends the range still farther east.

Genus CALCARINA d'Orbigny, 1826.

Calcarina mayori Cushman, new species.

(Plate 14, Figures 4 to 7.)

Test rotaliform, composed of several coils, chambers numerous, except the last one or two hidden by the secondary growth of short, blunt spines which covers the test even in the early stages, peripheral margin with 8 to 10 radial spines, clothed with outwardly pointing spines.

Diameter without spines slightly more than 1 mm.; with spines 2 mm.

Type specimens from station 2, others from the outer edge of the Aua Reef, Tutuila, and from stations 1, 3, and 5.

This species is the only one in the Samoan collections that I have seen. It is more blunt spined and of a slightly heavier build on the reef itself as in figures 6 and 7, and with much more slender spines in deeper water, figures 4 and 5. *C. mayori* is much less hispid and much thicker than *C. hispida,* very different in its secondary covering from *C. spengleri* and entirely different from *C. defrancii.* It may represent a localized development in the Samoan region. The species is named for the late Dr. A. G. Mayor.

Genus BACULOGYPSINA Sacco, 1893.

Baculogypsina sphærulatus (Parker and Jones).

(Plate 15, Figures 1 to 3.)

Orbitolina sphærulata Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 6, 1860, p. 33, No. 8.

Baculogypsina sphærulatus Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1900, p. 359, pl. 75, fig. 6.

Tinoporus baculatus H. B. Brady (not Montfort), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 716, pl. 101, figs. 4 to 7.

Test generally biconvex, the periphery somewhat acute, with 4 to 8 or more rather sharp, short spines, surface covered with a reticulated pattern of slightly projecting bosses, with connecting lines of clear shell material; early development consisting of one volution or slightly more of numerous chambers coiled as in *Calcarina,* after which the supplementary chambers are filled in rapidly on the surface, and the network of bosses and connecting

rods built up; the radial spines are always smooth, except for the slight channeling of the surface; color in fresh material often yellow or orange.

Diameter of Samoan specimens with spines slightly more than 2 mm.

The distribution of this species is apparently more restricted than that of many Indo-Pacific species. It occurred in the Samoan material commonly at station 1 and at the outer edge of the Aua Reef, Tutuila, rarely at station 8. Probably its preferred habitat is in shallow water. It is abundant in tropical Australian collections, such as that I have had from the Great Barrier Reef region at Murray Island. Brady's records are as follows: 6 *Challenger* stations off Fiji, 12 fathoms, at 4 stations south of New Guinea, 6 to 155 fathoms, and off the Admiralty Islands, 15 to 35 fathoms. He also mentions its occurrence on the shores of New Zealand, Australia, the Samoan Islands, Tasmania, and the Philippines. It is very rare in all the Philippine collections I have had, and Millett records it as very rare in the Malay region. Heron-Allen and Earland do not record it from the Kerimba region of Eastern Africa. Chapman found it to be remarkably abundant at Funafuti and states that the beach sand of the lagoon is largely composed of it, but that it occurs rarely in the waters of the lagoon. He describes a variety that should be known as *Baculogypsina sphærulatus* (Parker and Jones) var. *florescens* (Chapman) in which the tips of the spines become flattened and divided into separate spurs.

From the available collections the species appears to be abundant in shoal water of the tropical South Pacific, with much less numbers northward to the Philippines and southward to Tasmania.

The young specimens (plate 15, figs. 1, 2) are entirely *Calcarina*-like and later the secondary development entirely obscures this stage. The Samoan material is excellent to show these developmental stages.

Genus GYPSINA Carter, 1877.

Gypsina globulus (Reuss).

Ceriopora globulus Reuss, Haidinger's Nat. Abh., vol. 2, 1847, p. 33, pl. 5, fig. 7.

Gypsina globulus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 717, pl. 101, fig. 8.—H. B. Brady, Parker and Jones, Trans. Zool. Soc. London, 1888, p. 229, pl. 46, fig. 13.—Chapman, Proc. Zool. Soc. London, 1895, p. 44; Journ. Linn. Soc., Zool., vol. 28, 1900, p. 198; 1902, p. 407.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 140, pl. 13, fig. 10.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1041.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 727; Trans. Linn. Soc. Zool., vol. 11, 1916, p. 278; Journ. Roy. Micr. Soc., 1916, p. 53.—Cushman, Carnegie Inst. Wash. Pub. 291, 1919, p. 44, pl. 4, fig. 7; 13th Ann. Rept. Florida Geol. Survey, 1921, p. 53; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 360.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 221.

Test spherical or generally globular; surface regularly pitted with a more or less regular polygonal network; earliest chambers spiral, followed quickly by a mass of chambers covering the entire exterior; outer chamber walls finely perforated, forming the aperture; color white.

Diameter of Samoan specimen 0.4 mm.

From the outer edge of the Aua Reef, Tutuila.

This species is characteristic of coral reefs in the Indo-Pacific and is recorded from about the British Isles and the Abrohlos Bank. I failed to find it in the West Indian material I have had, but it may occur as a fossil. The large form which is so characteristic of the Bowden formation of Jamaica is var. *pilaris* (H. B. Brady).

Gypsina inhærens (Schultze).

Acervulina inhærens Schultze, Org. Polythal., 1854, p. 68, pl. 6, fig. 12.

Gypsina inhærens H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 718, pl. 102, figs. 1 to 6.—H. B. Brady, Parker and Jones, Trans. Zool. Soc. London, 1888, p. 229, pl. 41, fig. 19.—Flint, Ann. Rept. U. S. Nat. Mus., 1897 (1899), p. 336, pl. 79, fig. 6.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 198; 1902, p. 407.—Dakin, Rept. Pearl Oyster Fisheries Ceylon, 1906, p. 240.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p. 140; Subantarctic Islands of New Zealand, 1909, p. 363.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 691; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 141.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 74, pl. 21, figs. 6, 7.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 724; Trans. Linn. Soc. Zool., vol. 11, 1916, p. 278; Journ. Roy. Micr. Soc., 1916, p. 53.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 631; Carnegie Inst. Wash. Pub. 291, 1919, p. 43.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 221.

Test in its very earliest stages spiral, soon becoming an irregular incrusting mass adapting its form to the object to which it is attached; chambers distinct; wall perforate.

Samoan specimen from station 1.

The species seems to be widely distributed.

Gypsina vesicularis (Parker and Jones), var. squamiformis Chapman.

(Plate 15, Figure 4.)

Gypsina vesicularis (Parker and Jones), var. *squamiformis* Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 200, pl. 19, figs. 15*a*, *b*; 1902, p. 407.—Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 727.

"Test thin, normally attached, encrusting surfaces of organisms. Full-sized specimens measure about 3 or 4 mm. in diameter. Shell consists of a single layer of acervuline chambers."

Diameter of largest Samoan specimen 1.25 mm.

Specimens occurred at stations 1 and 9.

Chapman described this species from the lagoon at Funafuti. Heron-Allen and Earland record a few specimens from the Kerimba Archipelago, but note that they are not typical. It either seems to be a rare form or else has been overlooked.

Genus POLYTREMA Risso, 1826.

Polytrema miniaceum (Gmelin).

Millepora miniacea Linnaeus, Syst. Nat., ed. 13 (Gmelin's), vol. 1, pt. 6, 1788, p. 3784, No. 6.

Polytrema miniaceum Blainville, Dict. Sci. Nat., vol. 42, 1826, Atlas, Zooph., vol. 1, p. 17.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 721, pl. 100, figs. 5 to 9.—Hickson, Trans. Linn. Soc. London, Zool., fol. 14, 1911, p. 453, pl. 30, fig. 1; pl. 31, fig. 8; pl. 32, figs. 18, 23, 27, 31.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 75, pl. 18, fig. 6; pl. 20, fig.4.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 728.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 363.

Test attached, early portion close coiled, consisting of several chambers, later portion consisting of a mass of small chambers arranged in irregular layers, usually becoming arborescent; wall areolated, coarsely perforate; color light red or pinkish.

Height of Samoan specimens 1.75 mm.

The only specimens I have are from station 1.

This is undoubtedly a common species at Samoa, but I have had no large material such as would have it attached. The few specimens are attached to shell fragments. It is a common species of the coral-reef region of the Pacific, but apparently does not occur in the Atlantic, where it is replaced by *Homotrema*.

Family NUMMULITIDÆ.

Genus NONIONINA d'Orbigny, 1826.

Nonionina scapha (Fichtel and Moll.)

(Plate 16, Figure 1.)

Nautilus scapha Fichtel and Moll, Test. Micr., 1803, p. 105, pl. 19, figs. *d* to *f*.

Nonionina scapha Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 102, No. 4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 730, pl. 109, figs. 14, 15, 16?—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 28, pl. 15, fig. 1; pl. 16, figs. 3, 4.

Test free, bilaterally symmetrical, last-formed coil of about 10 chambers, increasing somewhat in length as added, periphery rounded, apertural face rounded truncate, sutures distinct, slightly depressed; wall finely punctate, slightly umbilicate; aperture at the base of the last-formed chamber on the median line.

Length of Samoan specimens 0.35 mm.

Specimens only from stations 2, 7, and 9.

This is somewhat different from the original figure of Fichtel and Moll, the apertural face broader and the chambers somewhat more elongate. So many forms have been put under name of this species that I have not tried to give a full synonymy. It is worthy of note here that Brady gives the South Pacific and Australian regions as the only part of the oceans where this species is not characteristic.

Nonionina subturgida Cushman, new species.

(Plate 16, Figure 2.)

Test bilaterally symmetrical, compressed, last-formed coil composed of 8 or 9 chambers, greatly increasing in length as added, the last-formed one extending the entire length of the test; periphery rounded; sutures very slightly depressed, distinct; apertural face broadly rounded, umbilical area often filled with secondary material; aperture at the base of the last-formed chamber at the median line.

Length of Samoan specimens up to 0.65 mm.

Type specimen from station 9, in 50 fathoms. It also occurred at station 7.

This is a much more rounded form than Williamson's *N. turgida* and may be characteristic of this South Pacific region. *N. turgida* is recorded from the Indo-Pacific by several writers, but figures are not given.

Nonionina umbilicatula (Montagu), var. pacifica Cushman, new variety.

(Plate 16, Figure 3.)

Test much more compressed than in the typical, the sutures distinct but not at all limbate; wall finely and evenly punctate.

Diameter of Samoan specimen 0.5 mm.

Type specimen from station 1.

This is very different from typical *N. umbilicatula* (Montagu) and may be specifically distinct. Material was not in sufficient quantity to be sure of this. The typical form of the species is rather well distributed in colder waters and very seldom recorded from shallow water in the tropics, which seems to indicate that the Samoan form may be a valid species.

Genus POLYSTOMELLA Lamarck, 1822.

Polystomella milletti Heron-Allen and Earland.

(Plate 16, Figures 7, 8.)

Polystomella verriculata Millett (not H. B. Brady), Journ. Roy. Micr. Soc., 1904, p. 604, pl. 11, fig. 3.

Polystomella milletti Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 735, pl. 53, figs. 38 to 42.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 263.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 633.

Test free, consisting of 2 to 3 coils, the last-formed one composed of from 10 to 12 chambers, somewhat inflated; sutures somewhat depressed, indistinct, nearly the whole surface covered with secondary material forming fine spinose projections, those on the chambers tending to assume a chevron-like pattern with the angle pointing toward the periphery; aperture at the base of the last-formed chambers.

Length of Samoan specimens up to 0.5 mm.

Specimens from station 2.

This is an Indo-Pacific species. Millett had it from the Malay region. Heron-Allen and Earland record it from 15 stations in the Kerimba Archipelago. Sidebottom had it from 465 fathoms off the eastern coast of Australia, and I have had less typical material from off New Zealand.

It is a very beatifully ornamented species and allied to a number of others forming an Indo-Pacific group with modifications of this general form of surface decoration.

Polystomella advena Cushman.

Polystomella subnodosa H. B. Brady (not Münster), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 734, pl. 110, figs. 1*a*, *b*.—Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1902, p. 203.—Millett, Journ. Roy. Micr. Soc., 1904, p. 604.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 165.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 733.

Polystomella advena Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 56, pl. 9, figs. 11, 12.

Test equally biconvex; periphery acute, with a narrow carina, somewhat lobulate; umbilical region depressed, with a small central boss of clear shell material, not extending out to the general contour of the test; retral processes about one-fourth the width of the chamber, in depressed channels above the sutures, the intermediate portions being raised, inflated, gradually increasing in width toward the periphery; wall smooth, translucent, with

very minute punctæ; aperture a series of small rounded pores at the base of the apertural face of the chamber.

Diameter of Samoan specimens up to 0.5 mm.

Specimens occurred at stations 1, 2, 3, 7, 8, and 9.

This is the species of the Indo-Pacific and Tortugas regions that has been called *P. subnodosa* by numerous authors but which is distinct from that species.

Polystomella jenseni Cushman, new species.

(Plate 16, Figures 4?, 6.)

Polystomella macella (Fichtel and Moll), var., Jensen, Proc. Linn. Soc. New South Wales, vol. 29, 1904 (1905), p. 817, pl. 23, fig. 4.

Test much compressed, biconcave, the sutural lines somewhat raised, retral process elongate, thin, bridging the area between the sutures, leaving flat depressed areas between, periphery thin, truncate.

Diameter up to 0.6 mm.

Specimens have occurred at stations 2, 3, 5, and 9.

This is evidently the species figured by Jensen in the reference given above. His specimens were from 100 fathoms off Australia.

Polystomella sp.?

(Plate 16, Figure 5).

The figure gives a good idea of this rounded species. It was found in material from station 2 but not elsewhere.

Genus AMPHISTEGINA d'Orbigny, 1826.

Amphistegina madagascarensis d'Orbigny.

(Plate 17, Figure 3.)

Amphistegina madagascarensis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 305, No. 5.—Fornasini, Rend. Acad. Sci. Bologna, vol. 7, 1903, p. 144, pl. 2, fig. 5.

Amphistegina lessonii d'Orbigny, var. *madagascarensis* Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 736.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 372.

Test carinate, unequally biconvex, chambers comparatively few; sutures evenly curved, somewhat depressed; periphery acute; wall smooth, except near the aperture where it is spinose.

Diameter of Samoan specimens not exceeding 1.5 mm.

Specimens occurred on the outer edge of the Aua Reef at Tutuila and at stations 1, 5, and 9.

This form certainly seems worthy of specific rank, as it is very different from most of the other forms assigned to *A. lessonii* d'Orbigny. It is apparently an Indo-Pacific species.

Amphistegina radiata (Fichtel and Moll).

(Plate 17, Figures 1, 2.)

Nautilus radiatus Fichtel and Moll, Test. Micr., 1798, p. 58, pl. 8, figs. 8*a* to *d*.

Amphistegina radiata Chapman, Proc. Zool. Soc. London, 1895, pp. 45–47, pl. 1, figs. 8 to 10, 12.

Amphistegina lessonii d'Orbigny, var. *radiata* Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 736.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 372.

Test large, compressed, equally biconvex, chambers numerous; sutures with a very sharp angle, of clear shell material, not depressed; surface smooth or beaded usually not distinctly spinose near the aperture.

Diameter of Samoan specimens up to 2 mm. or more.

Specimens occurred on the outer edge of the Aua Reef, Tutuila, and at stations 1, 5, and 9.

There is a smaller, much beaded form at some of the stations (plate 17, fig. 2).

Genus OPERCULINA d'Orbigny, 1826.

Operculina gaimairdi d'Orbigny.

(Plate 17, Figure 4.)

Operculina gaimairdi d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 281, No. 5.—Fornasini, Boll. Soc. Geol. Ital., vol. 22, 1903, pl. 14, fig. 4.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 375.

Test of medium size, much compressed, complanate, opaque; chambers numerous, curved; sutures distinct; the peripheral keel distinct; central area somewhat enlarged in megalospheric specimens; the remainder of the test marked by chains of beads along the sutures, the intermediate areas smooth and unornamented.

Diameter of Samoan specimens 2.5 mm.

Specimens occurred at stations 1, 2, and 5.

This species seems to be a common one, but is rather distinct from the others wherever I have found it.

Operculina bartschi Cushman, var. plana Cushman.

(Plate 17, Figures 5, 6.)

Operculina bartschi Cushman, var. *plana* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 377, text fig. 14.

Test very much compressed, the central portion ornamented by occasional rounded knobs or bosses on the chambers between the sutures, the later chambers of the uncoiled portion entirely unornamented; sutures distinct but not ornamented.

Diameter of Samoan specimens 2.5 mm.

Specimens only from station 9.

This variety was described from the Philippines, and this extends its range considerably to the south.

Genus OPERCULINELLA Yabe, 1918.

Operculinella venosa (Fichtel and Moll).

(Plate 17, Figure 7.)

Nautilus venosus Fichtel and Moll, Test. Micr., 1798, p. 59, pl. 8, figs. *e* to *h*.

Nummulites venosa Chapman, Proc. Zool. Soc. London, 1895, p. 47.

Operculina venosa Chapman, Proc. Roy. Soc. Victoria, vol. 26, 1913, p. 173.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 383.

Amphistegina cumingii Carpenter, Philos. Trans., 1859, p. 32, pl. 5, figs. 13–17.

Nummulites cumingii H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 749, pl. 112, figs. 11–13, woodcut, fig. 22.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 39, pl. 14, fig. 6.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 739.

Operculinella cumingii Yabe, Sci. Repts. Tohoku Imp. Univ., ser. 2 (Geology), vol. 4, 1918, p. 126, pl. 17, figs. 8 to 12.

Test free, involute, biconvex, early portion thick, later portion making a wide thin flange about the central portion; sutures fairly distinct; supplementary canal system well developed; edge of test carinate in the flange-like portion.

Diameter of Samoan specimens up to 2.5 mm.

Specimens from station 1 only.

This is very rare in the Samoan material. Its range extends from the coast of Eastern Africa to Samoa and from the Philippine region, Midway Island, and the Hawaiian Islands southward to Australia.

Yabe has recorded it as a fossil from Japan. This is evidently not *Nummulites,* as I have noted before, and it seems that the new genus proposed for it by Yabe should be used.

Genus HETEROSTEGINA d'Orbigny, 1826.

Heterostegina suborbicularis d'Orbigny.

Heterostegina suborbicularis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 305.—Fornasini, Boll. Soc. Geol. Ital., vol. 22, 1903, pl. 14, fig 6.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 385.

Test free, central portion thickened and involute; peripheral portion thin especially toward the periphery, subdivisions of the chambers not appearing until the flange is developed; wall smooth.

Diameter of Samoan specimens up to 4 mm.

Specimens occurred at stations 2 and 3, with some young, very flat ones which may not be this at station 9.

This species is very common in some parts of the Philippines. d'Orbigny's material was from the Indo-Pacific.

Family MILIOLIDÆ.

Genus CORNUSPIRA Schultze, 1854.

Cornuspira involvens Reuss.

(Plate 18, Figures 1, 2.)

Operculina involvens Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 370, pl. 45, fig. 20.
Cornuspira involvens Reuss, Sitz. Akad. Wiss. Wien, vol. 48, 1863 (1864), p. 39, pl. 1, fig. 2.—H. B. Brady, Rep. Voy. *Challenger,* Zoology, vol. 9, 1884, p. 200, pl. 11, figs. 1 to 3.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 25, pl. 1, fig. 2; pl. 2, fig. 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 389; Carnegie Inst. Wash., Pub. 311, 1922, p. 58.

Test biconvex, the edges becoming somewhat thicker as coils are added, slightly embracing; wall smooth; aperture nearly the size of the open end of the tube.

Diameter of Samoan specimens not over 0.5 mm.

Single specimens from stations 1, 6, and 9.

Both megalospheric (plate 18, fig. 2) and microscopic (fig. 1) specimens occur. In the former the size of the tubular chamber changes very little in size, but in the latter there is a very great increase in diameter from the earlier coils to the later ones and the whole test attains a much greater size.

Genus NUBECULARIA Defrance, 1825.

Nubecularia tubulosa Heron-Allen and Earland, var. subdecorata Cushman, new variety.

(Plate 18, Figure 4.)

Test attached, consisting of an irregularly branching series of tubular chambers, the earliest part coiled or milioline, the whole test of rather uniform diameter; wall porcellanous, smooth within but covered by included sand grains; aperture at the open ends of the tubular chambers.

Diameter of chambers 0.35 to 0.5 mm.

Type specimen from station 2.

This is evidently closely related to Heron-Allen and Earland's *N. tubulosa* but differs in the character of the surface and the more jointed test. The surface character is given by included sand grains of fairly uniform size and not by an ornamentation of the test itself, as in their *N. lucifuga,* var. *decorata.*

It is related to *N. antillarum* Cushman (Carn. Inst. Wash., Pub. 311, 1922, p. 58, text figs. 7, 8), which is also a branching tubular form from the West Indies, where it occurs abundantly on the leaves of *Posidonia* in shallow waters of coral reefs.

Nubecularia lucifuga Defrance.

(Plate 18, Figure 3.)

Nubecularia lucifuga Defrance, Dict. Sci. Nat., vol. 35, 1825, p. 210; Atlas. Zooph. pl. 44, fig. 3.—H. B. Brady, Rep. Voy. *Challenger,* Zoology, vol. 9, 1884, p. 134, pl. 1, figs. 9 to 16.—Chapman, Proc. Zool. Soc. London, 1895, p. 7.—Millett, Journ. Roy. Micr. Soc., 1898, p. 261, pl. 5, fig. 7.—Chapman, Journ. Linn. Soc., Zool., vol. 28, 1900, p. 168; 1902, pp. 381, 386, 398.—Earland, Journ. Roy. Micr. Soc., 1905, p, 191.—Chapman, Subantarctic Islands of New Zealand, 1909, p. 313.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 309; Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 20; Trans. Zool. Soc. London, vol. 20, 1915, p. 549.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 635.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 60.

Test normally attached, consisting of a more or less coiled series of inflated chambers; wall porcellanous, in the typical form smooth.

Length of Samoan specimen 0.75 mm.

Only specimen from station 2.

This is widely distributed in the Indo-Pacific and the North Atlantic material has been referred to the same species.

Genus NUBECULINA Cushman, new genus.

Nubecularia (in part) H. B. Brady (type species *N. divaricata* (H. B. Brady)), Rep. Voy. *Challenger,* Zoology, vol. 9, 1884, p. 133.

Test elongate, uniserial, initial end coiled or milioline, chambers increasing in size as added; wall porcellanous with attached sand grains; aperture elongate, tubular, with an everted phialine lip and the apertural opening with inwardly pointing teeth.

Brady's species *N. divaricata* is very different from typical coiled, attached species of *Nubecularia.* This genus is erected for *N. divaricata,* which, with its uniserial test and peculiar apertural characters, is unique among the Miliolidæ.

Nubeculina divaricata (H. B. Brady), var. advena Cushman, new variety.

(Plate 19, Figures 1 to 4.)

Test free, elongate, tapering from the initial end, broadest at the last-formed chamber; composed of several uniserial chambers, the initial end milioline; wall porcellanous, the exterior with included sand grains; aperture elongate, tubular, with an everted phialine lip and the apertural opening with a series of inwardly pointing teeth.

Length of Samoan specimens up to 2.5 mm.

Specimens occurred at stations 1, 2, 3, and 9; abundant at the first of these.

Except for the specimens figured by Sidebottom from the Mediterranean, which are not typical as he notes, all the other records for *N. divaricata* are from the Indo-Pacific.

Brady had only three records: Humboldt Bay, on the north coast of New Guinea, 37 fathoms; off Raine Island, Torres Strait, 155 fathoms, and off Tongatabu, Friendly Islands, 18 fathoms. Millett records it as rare at 3 stations in the Malay region in shallow water. All Chapman's records from about Funafuti are marked rare or very rare. Heron-Allen and Earland record it from the Kerimba Archipelago as very rare at two stations. They record it as attached to shell fragments.

It is interesting in view of the above records to note the relative abundance of this variety at at least one of the Samoan stations. It is very different from the typical form of the species which has slender stolon-like connections between the chambers and very different apertural characters.

Nubeculina divaricata (H. B. Brady), var. gracilis Cushman, new variety.

(Plate 18, Figures 5, 6.)

Variety differing from the typical in the much more slender test and the separate spacing of the chambers.

Type from station 9, in 50 fathoms.

This is a more slender form than the preceding but more like that variety than like the typical form of the species.

Genus NODOBACULARIA Rhumbler, 1895.

Nodobacularia tibia (Jones and Parker)

(Plate 19, Figure 10.)

Nubecularia tibia Jones and Parker, Quart, Journ. Geol. Soc., vol. 16, 1860, p. 455, pl. 20, figs. 48 to 51.—H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 52, pl. 8, figs. 1, 2; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 135, pl. 1, figs. 1 to 4.

Nodobacularia tibia Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 39, pl. 8, figs. 1, 2; Carnegie Inst. Wash. Pub. 311, 1922, p. 59, pl. 11, fig. 1.

There is a single specimen from station 1 which shows the last two chambers of a specimen of this species.

Genus FISCHERINA Terquem, 1878.

Fischerina pellucida Millett.

(Plate 19, Figure 9.)

Fischerina pellucida Millett, Journ. Roy. Micr. Soc., 1898, p. 611, pl. 13, figs. 14, 15.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 591.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 636.

Test composed of a few coils, laterally compressed, the early portion undivided, the last-formed coil divided usually into 5 or 6 chambers, depressed, umbilicus excavated; periphery rounded, slightly lobulated; wall smooth and translucent; aperture large, at the end of the last-formed chamber.

Diameter of Samoan specimen 0.5 mm.

A single specimen from station 2.

This is a little recorded but widely distributed species in the Indo-Pacific. Millett found it in the Malay Archipelago, Heron-Allen and Earland from the Kerimba Archipelago on the southeastern coast of Africa, and I have had it from off New Zealand and now from Samoa.

Genus TUBINELLA Rhumbler, 1906.

Tubinella funalis (H. B. Brady).

(Plate 19, Figures 7, 8.)

Articulina funalis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 185, pl. 13, figs. 6 to 11.

Test elongate, cylindrical, slightly tapering, the initial chamber elongate, bulbous, rounded at the base, remainder of chambers indistinct; wall with very fine longitudinal striæ; aperture formed by the open end of the last-formed chamber.

Length of Samoan specimens up to 1.5 mm.

Specimens from station 9 only.

This is evidently a widely distributed species, Brady's records including the region of Prince Edwards Island, Kerguelen Island, and New Guinea.

Other authors have recorded but not usually figured the species. Heron-Allen and Earland found this very abundant in their material from the Antarctic (British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 72). They note that the early chamber is not milioline, as was suspected by Brady, but is single. That accords with the Samoan material.

Rhumbler has erected a new genus for this and allied species, and it seems that it should be used, for this is certainly very different from typical *Articulina*.

With this are specimens which may be referred to var. *inornata* (H. B. Brady) in that they are smooth and unornamented. The proloculum is, however, much broader than in the typical form.

Tubinella chapmani Cushman, new species.

(Plate 19, Figures 5, 6.)

Articulina funalis Chapman (not H. B. Brady), Subantarctic Islands of New Zealand, 1909, p. 323, pl. 14, fig. 3.

Test elongate, cylindrical, the proloculum or initial chamber of greater diameter than the cylindrical portion, the initial end bluntly pointed; surface ornamented with a few coarse longitudinal costæ.

Length of Samoan specimens up to 0.8 mm.

Type specimens from station 9.

Among the specimens figured by Chapman, the above reference seems to show a specimen similar to that here figured. It seems very different from *T. funalis* in the shape of the proloculum, which is fusiform and bluntly pointed, and in the much coarser ornamentation. Chapman's specimen here referred to was from 20 miles north of Auckland Island, in 85 fathoms.

Genus SPIROLOCULINA d'Orbigny, 1826.

Spiroloculina antillarum d'Orbigny.

(Plate 20, Figure 1.)

Spiroloculina antillarum d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiferes," p. 166, pl. 9, figs. 3, 4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 155, pl. 10, figs. 21*a*, *b*.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 407, pl. 81, figs. 4*a*, *b;* pl. 83, fig. 4?—Carnegie Inst. Wash. Pub. 311, 1922, p. 61.

Spiroloculina grata Terquem (?) and late authors.

Test elongate, elliptical; chambers nearly circular in transverse section; surface ornamented by numerous longitudinal costæ, often slightly oblique, both ends of the chamber projecting and the intermediate portions thus left either filled by a plate of clear material or occasionally open; apertural end projecting and forming a cylindrical neck with a slight lip and a single tooth, sometimes bifid at the tip.

Length of Samoan specimens up to 1 mm.

There are specimens in the collections from stations 1, 2, 5, 6, and 9, as well as from the outer edge of the Aua Reef, Tutuila.

This is a very characteristic species of coral reefs, both in the Atlantic and Pacific.

Spiroloculina antillarum d'Orbigny, var. angulata Cushman.

(Plate 20, Figure 2.)

Spiroloculina grata H. B. Brady (in part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 10, figs. 22, 23.

Spiroloculina grata Terquem, var. *angulata* Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 36, pl. 7, fig. 5.

Spiroloculina antillarum d'Orbigny, var. *angulata* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 408, pl. 81, figs. 5*a*, *b;* Carnegie Inst. Wash. Pub. 311, 1922, p. 62.

Variety differing from the typical in the angular form of the chamber instead of cylindrical.

With the typical form of the species at stations 1, 2, 5, and 9, as well as the outer edge of the Aua Reef at Tutuila.

Spiroloculina grateloupi d'Orbigny.

(Plate 20, Figures 3, 4.)

Spiroculina grateloupi d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 298.—Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 59.

Test elongate, broadest in the center, tapering toward either end; chambers thickening as added; periphery broader than central portion; periphery convex; edges of the chamber somewhat keeled, final chamber projecting at the apertural end, very slightly at the initial end; aperture tubular, with a slight lip, usually with a pair of bifid teeth; surface dull, with many small incised lines longitudinally of the test.

Length of Samoan specimens up to 1.60 mm.

Specimens from stations 1, 2, 3, 5, 6, 8, and 9.

This is a very different species from *S. mayori,* very much less excavate, all the chambers visible, with almost no overlapping, the apertural neck stout, and the surface incised with a great many fine longitudinal lines. Whether or not this is really identical with d'Orbigny's *S. grateloupi* may be questioned until the original material of that species is examined.

Spiroloculina mayori Cushman, new species.

(Plate 20, Figures 5, 6.)

Test elongate, the surface largely made up of the last 2 chambers, periphery excavated, the sides of the chamber sharply keeled, central part of the test very much depressed; apertural end of the chamber much extended, slender, with a phialine lip; basal end projecting; wall matt.

Length of Samoan specimens up to 1 mm.

Type specimens from station 1, others from stations 2, 3, 5, and 9.

This is probably the Pacific form, which has been called *S. grateloupi* in my Philippine report, at least in part. It is very deeply excavated in front view, the last two chambers overlapping all but the very center.

Spiroloculina acutimargo H. B. Brady?

There is a single specimen from station 9 that is like the specimen I have figured under this name (Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pl. 5, fig. 1) from off Guam. I have already noted the various forms that are included by Brady under this name.

Our specimens from Samoa and Guam do not fit well with any of Brady's figures.

There are also specimens from stations 2 and 9 that are identical with plate 10, figure 14 of the *Challenger* Report.

Spiroloculina eximia Cushman.

(Plate 21, Figure 2.)

Spiroloculina eximia Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 61, pl. 11, fig. 2.

Test small, elongate, elliptical, periphery convex, the opposite faces concave, ends of the chamber projecting; sutures fairly distinct, the outer angle of each chamber projecting above the inner portion of the adjacent

next-formed chamber; wall with a granular dull surface, apertural end with a projecting cylindrical neck, circular, with a single, very thin, slightly bifid tooth.

Length of Samoan specimens up to 0.45 mm.

Specimens from stations 1, 4, and 7.

This species, originally described from the Tortugas region, seems to be characteristic also of the South Pacific. It is a very striking species in spite of its small size and is difficult to show in a drawing.

Spiroloculina affixa Terquem.

(Plate 21, Figure 3.)

Spiroloculina affixa Terquem, Mem. Soc. geol. France, ser. 3, vol. 1, 1878, p. 55, pl. 5 (10), figs. 13*a* to *c*.—Howchin, Trans. Roy. Soc. South Australia, vol. 12, 1889, p. 2.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1907, p. 16, pl. 1, figs. 23 to 25.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 635; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 410, pl. 83, figs. 2*a* to *c*.

Spiroloculina inæquilateralis Schlumberger, Mem. Soc. Zool. France, vol. 6, 1893, p. 201, pl. 4, figs. 84 to 86; fig. 3 (in text).—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 2, pl. 1, fig. 2.

Spiroloculina acutimargo H. B. Brady (in part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 10, fig. 12 (not figs. 13 to 15); Sidebottom (in part), Journ. Roy. Micr. Soc., 1918, p. 5.

Test elongate, fusiform, the sides very different from one another, one side flattened, the other deeply concave; chambers with definite sutures which are flush with the surface; wall thin and smooth; peripheral face somewhat concave, peripheral margin somewhat carinate, apertural end subacute; aperture elliptical, compressed.

Length of Samoan specimen 0.6 mm.

The only specimen which is more typical than the figure shows is from station 1. There are numerous records for this species in the Indo-Pacific.

Spiroloculina canaliculata d'Orbigny.

(Plate 21, Figure 1.)

Spiroloculina canaliculata d'Orbigny, Foram. Foss. Vienne, 1846, p. 269, pl. 16, figs. 10 to 12.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 30, pl. 4, figs 1 to 3; Bull. 100, vol. 4, 1921, p. 395, pl. 80, figs. 3*a*, *b*.

Spiroloculina impressa H. B. Brady (not Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 151, pl. 10, figs. 3, 4.

Test elongate, elliptical, much compressed, only slightly depressed in the middle, chambers nearly square in transverse section, the outer margins keeled; apertural end extended into a cylindrical neck, the aperture with a distinct phialine lip and bifid tooth; wall smooth usually with a glossy surface.

Length of Samoan specimens up to 1.50 mm.

This is a characteristic species of coral-reef material of the Indo-Pacific usually recorded as *S. impressa*. Our figure shows a specimen with an unusually slender neck.

Spiroloculina planissima (Lamarck).

Miliolites planulata Lamarck, var. *planissima* Lamarck, Hist. Nat. Anim. sans Vert., vol. 2, 1816, p. 613, No. 4*c*.

Spiroloculina planissima Wiesner, Archiv. Prot., vol. 25, 1912, p. 209.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 556, pl. 41, figs. 1 to 5.

Test much compressed, broadly oval, chambers somewhat overlapping, the periphery developing a thin keel; wall smooth and shining, apertural end with a short neck and very slight lip, the aperture itself somewhat compressed, with a bifid tooth.

Length of Samoan specimens slightly more than 1 mm.

Specimens from stations 1 and 9.

These specimens from Samoa are slightly shorter and more rounded than those figured by Heron-Allen and Earland from the Kerimba Archipelago. It is one of the finest species of the genus and probably has a wide Indo-Pacific distribution.

Spiroloculina planissima (Lamarck), var. samoaensis Cushman, new variety.

(Plate 21, Figures 9, 10.)

Variety differing from the typical in the broader form and the ornamentation consisting of oblique costæ running in part way from the border of the test.

Type specimens from station 2, others from station 1.

This is a very beautifully ornamented variety, some of the specimens which were probably living when dredged with dark markings.

Genus VERTEBRALINA d'Orbigny, 1826.

Vertebralina striata d'Orbigny?

There is a single specimen from the outer edge of the Aua Reef, Tutuila that is identical with the specimens figured by Brady (Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 12, figs. 15 and 16). I do not think that this is the same as d'Orbigny's *V. striata,* but have not the means at hand to determine this with certainty. The originals of figs. 15 and 16 of Brady are from *Challenger* station 187, off Booby Island, Torres Strait, in 8 fathoms.

Genus QUINQUELOCULINA d'Orbigny, 1826.

Quinqueloculina alveoliniformis (H. B. Brady).

(Plate 21, Figure 8.)

Miliolina alveoliniformis H. B. Brady, Quart, Journ. Micr. Sci., vol. 19, 1879, p. 268; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 181, pl. 8, figs. 15 to 20.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 232, pl. 2, figs. 17 to 19.—Millett, Journ. Roy. Micr. Soc., 1898, p. 510.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 177; vol. 30, 1910, p. 398.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 581.

Quinqueloculina alveoliniformis Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 43; Bull. 100, vol. 4, 1921, p. 443; Carnegie Inst. Wash. Pub. 311, 1922, p. 64.

Test elongate, fusiform, composed of numerous chambers, long and narrow, 5 to 8 visible from the exterior; wall in young specimens thin and porcellanous, in adults covered with sand-grains; aperture composed of numerous pores or radiate, often indistinct.

Length of Samoan specimens up to 2.3 mm.

Specimens occurred in the material from stations 1, 2, and 5.

Except for specimens from the West Indian region, this species seems to be Indo-Pacific in its distribution. It is characteristic of coral-reef conditions.

Quinqueloculina samoaensis Cushman, new species.

(Plate 21, Figures 4 to 7.)

Test slightly longer than broad, periphery either squarish in the adult or with a blunt keel in the young, often sinuous; wall thick, with an encrusting of fine sand grains, initial end of the chamber extended and the apertural end elongated slightly into a cylindrical neck with a phialine lip and single tooth.

Length up to 0.85 mm.

Type specimens from station 1. It also occurs at stations 3, 4, 5, 6, 7, 8, and 9. It is one of the most abundant species in the collection.

It differs from the other species with arenaceous coverings on the walls, in the peculiar shape and character of the chambers, as well as in the apertural characters.

Quinqueloculina bidentata d'Orbigny.

(Plate 22, Figures 1, 2.)

Quiqueloculina bidentata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiferes," p. 197, pl. 12, figs. 18 to 20.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 11, 12; Carnegie Inst. Wash. Pub. 311, 1922, p. 54.

Test somewhat longer than broad; chambers distinct; periphery squarely truncate; wall composed of rather coarse sand grains; apertural end projecting, with a slightly thickened lip; aperture with a thin tooth with a bifid tip.

Length of Samoan specimens up to 1.15 mm.

Specimens from stations 1, 2, and the outer edge of the Aua Reef.

This has hitherto been known only from the West Indian region, but these specimens from Samoa seem to be very closely allied to the Atlantic ones. They have the same squarish chambers. The specimen figured, while one of the best in many ways, did not have the bifid tooth, although others did have this character.

Quinqueloculina parkeri (H. B. Brady).

(Plate 22, Figure 3.)

"*Quinqueloculina* with oblique ridges," Parker, Trans. Micr. Soc. London, vol. 6, 1858, p. 53, pl. 5, fig. 10.

Miliolina parkeri H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 46; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 177, pl. 7, fig. 14.—Chapman, Proc. Zool. Soc. London, 1895, p. 11; Journ. Linn. Soc. Zool., vol. 28, 1900, p. 175; Proc. Zool. Soc. London; vol. 1, 1902, p. 231.—Dakin, Rept. Pearl Oyster Fisheries, Ceylon, 1906, p. 230.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 574, pl. 43, figs. 11, 12.

Quinqueloculina parkeri Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 50, pl. 15, fig. 3; Carnegie Inst. Wash. Pub. 213, 1918, p. 290; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 440, pl. 86, figs. 4*a* to *c*.

Test about twice as long as broad, periphery subacute, chambers distinct; sutures depressed; surface marked by a series of transverse ridges and alternating excavations not involving the peripheral margin; aperture with a slight lip, rectangular, with a single tooth.

Length of Samoan specimens up to 1 mm.

Specimens occurred at stations 1, 2, 3, and 5, as well as on the outer edge of the Aua Reef, Tutuila.

This is a characteristic Indo-Pacific specimen with the following records: "Essentially coral-reef species. It occurs at seven *Challenger* stations amongst the islands of the Pacific, and with one exception (off Tahiti, 420 fathoms), always in shallow water. It has also been found in sand dredged off the Seychelles (E. P. Wright), off Java (Robertson), and in the Red Sea" (Brady); Funafuti (Chapman), Ceylon (Dakin), Kerimba Archipelago (Heron-Allen and Earland), Malay region (Millett), Laysan (Rhumbler), Hawaiian Islands (Bagg). I have had it from Gaspar Straits; Apra Bay, Guam; off Hawaii; Murray Island, off Australia, and numerous stations in the Philippine region.

It is represented in the West Indian region by varietal forms.

Quinqueloculina anguina Terquem?

(Plate 22, Figure 4.)

Quinqueloculina anguina Terquem, Mem. Soc. Géol. France, sér. 3, fol. 1, Mém. 3, p. 78, pl. 9 (14), fig. 20.

There is a single specimen from station 3 which may possibly be referred to this species of Terquem.

Quinqueloculina anguina Terquem, var. agglutinans Wiesner.

(Plate 22, Figures 5, 6.)

Miliolina anguina Terquem, var. *agglutinans* Wiesner, in Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 575.

Test elongate, chambers rounded in transverse section, periphery rounded, apertural end extended, with a cylindrical neck and slight lip; surface incrusted with sand grains.

Length of Samoan specimens up to 0.45 mm.

Specimens occurred at stations, 1, 2, 5, and 9.

The neck is usually much longer and more slender than in the one figured here. Heron-Allen and Earland had this from the Kerimba Archipelago at several stations.

Quinqueloculina disparilis d'Orbigny, var. curta Cushman.

(Plate 22, Figures 7, 8.)

Quinqueloculina disparilis d'Orbigny, var. *curta* Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 49, pl. 14, fig. 2, text fig 30.

There are a few small specimens from the outer edge of the Aua Reef, Tutuila, which may belong to this variety. I originally described the variety from off Japan.

Quinqueloculina kerimbatica (Heron-Allen and Earland).

(Plate 22, Figure 9.)

Miliolina parkeri Millett, Journ. Roy. Micr. Soc., 1898, p. 507, pl. 12, fig. 4.
Miliolina kerimbatica Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 574, pl. 43, figs. 13 to 23.
Quinqueloculina kerimbatica Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 437.

Test free, quinqueloculine. The walls of the chambers thick, irregularly furrowed in all directions with broad, deeply gouged-out channels, running

obliquely and irregularly across the face of each chamber and generally connecting with a deeper straight furrow excavated down the peripheral edge. This straight peripheral furrow, when exposed on an earlier chamber in the center of the test by the quinqueloculine arrangement of the shell, affords a very striking appearance by contrast with the transverse furrows on the surface of the surrounding chambers. Aperture large and furnished with a prominent tooth. The oral end is usually but slightly produced, but in some individuals the aperture is situated on a produced neck. The ridges between the furrows are flat on the top—i.e., the furrows are cleanly gouged out of the shell substance.

The specimen figured is from station 1 and there is another from station 7 which closely resembles plate 43, figure 19, of Heron-Allen and Earland. Millett's figured specimen is referred by Heron-Allen and Earland to this species. This makes its range include the Kerimba Archipelago, Malay Region, the Philippines, and now Samoa.

Quinqueloculina kerimbatica (Heron-Allen and Earland), var. philippinensis Cushman.

Quinqueloculina kerimbatica (Heron-Allen and Earland), var. *philippinensis* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 438, pl. 89, figs. 2, 3.

Test elongate, quinqueloculine; peripheral margin of the chambers broadly rounded, sides convex, surface ornamented; the peripheral face with regular reticulations with thin walls between, large but very regular, sides either with the reticulate pattern entire, or becoming obsolescent or even wanting, especially in older specimens; apertural end of the chamber projecting and contracted to form an exsert cylindrical neck without ornamentation, with a thin border, not thickened, but with a phialine lip and a simple bifid tooth.

Length of Samoan specimens not exceeding 0.5 mm.

From station 1 only.

This is very typical and shows that this variety I described from the Philippines has a wide range. The specimens I have had from Gaspar Straits (Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pl. 16, fig. 1) and called *Q. reticulata* are undoubtedly this variety *philippinensis*.

There are specimens from the West Indian region somewhat similar.

Quinqueloculina striata d'Orbigny (?)

(Plate 22, Figure 10.)

From station 2 there is a single specimen here figured which may be referred to the form figured by Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, pl. 44, figs. 13 to 17). Their specimens were from the Kerimba Archipelago. It is also very close to a specimen which I have figured from the Hawaiian Islands (Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pl. 15, figs. 1*a* to *c*) as *Q. costata* d'Orbigny.

Quinqueloculina bicostata d'Orbigny.

(Plate 23, Figures 1, 2.)

Quinqueloculina bicostata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, p. 195, pl. 12, figs. 8 to 10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 47, pl. 13, fig. 1.

There are numerous specimens from station 9 that are very similar to those I have had from the Pacific, figured in the reference above.

Quinqueloculina vulgaris d'Orbigny (?)

There is a small smooth species which is fairly common in coral-reef material that has been referred to the above name. There is no type specimen figured that can be referred to with any degree of confidence, and the name may have to lapse in favor of some other. There are specimens from stations 1, 2, and 9 which are very similar to those I have figured from the Philippines (Bull. 100, U. S. Nat. Mus., vol. 4, 1921, pl. 87, figs. 1*a* to *c*).

From station 5 there is a varietal form with peculiarly ornamented walls. They have an incised pattern of short lines longitudinally placed.

Quinqueloculina spiralis Cushman.

Quinqueloculina spiralis Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 54, pl. 20, fig. 1.

There are 2 specimens from station 9 in 50 fathoms which are close to this species I described from off Guam. They have the same spirally twisted test and are even more conspicuously so.

Quinqueloculina undosa Karrer.

(Plate 23, Figures 3, 4.)

Quinqueloculina undosa Karrer, Sitz. Akad. Wiss. Wien, vol. 55, 1867, p. 361, pl. 3, fig. 3.
Miliolina undosa Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 572, pl. 43, figs. 1 to 4.

There are specimens of the elongate form comparable to the figures given above from stations 2 and 9. This is not the form figured by Brady under this name and which I have named *Q. bradyi*.

Quinqueloculina crassa d'Orbigny, var. subcuneata Cushman.

(Plate 23, Figure 7.)

Miliolina crassa Heron-Allen and Earland (part) (not d'Orbigny), Trans. Zool. Soc. London, vol. 20, 1915, p. 572, pl. 42, fig. 41 (not 37 to 40).
Quinqueloculina crassa d'Orbigny, var. *subcuneata* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 423, pl. 89, figs. 4*a* to *c*.

Test like the typical in ornamentation, but short and the chambers wedge-shaped, almost sharp at the peripheral angles.

Length of Samoan specimens 0.45 mm.

Specimens are from the outer edge of the Aua Reef, Tutuila, and from station 1.

This variety is now known from the Philippines, Kerimba Archipelago, and Samoa.

Quinqueloculina lamarckiana d'Orbigny.

Quinqueloculina lamarckiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 189, pl. 11, figs. 14, 15.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 13, 14; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 419, pl. 87, figs. 2, 3*a* to *c;* Carnegie Inst. Wash. Pub. 311, 1922, p. 64.

Quinqueloculina auberiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 193, pl. 12, figs. 1 to 3.

Quinqueloculina cuvieriana H. B. Brady (not d'Orbigny) Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 162, pl. 5, figs. 12 *a* to *c*.

Test nearly as broad as long; chambers distinct; sutures slightly depressed chambers generally triangular in transverse section, the angles subacute but not carinate; wall smooth and polished; apertural end of the chamber slightly extended, forming an elliptical neck without a definite lip, but with a narrow elongate tooth.

Length of Samoan specimens up to 0.6 mm.

Specimens from stations 3, 6 and 7.

Characteristic of West Indian region and also extends apparently to Indo-Pacific, where I have found it in the Philippine region.

Quinqueloculina seminulum (Linne).

(Plate 23, Figure 8.)

There is a single specimen from station 8 here figured which may be an elongate form of this species.

Quinqueloculina tropicalis Cushman, new species.

(Plate 23, Figures 9, 10.)

Miliolina gracilis H. B. Brady (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 160, pl. 5, figs. 3*a* to *c*.

Test elongate, two to three times as long as broad, periphery rounded, chambers distinct, circular in transverse section, surface granular, dull; apertural end with the neck level with the last-formed chamber or a little above, with a slight lip and single tooth.

Length up to 1 mm.

Types from station 3, others from station 5.

This is the form figured by Brady from Humboldt Bay, New Guinea, in 37 fathoms. In his Malay paper (J. R. M. S. 1898, p. 267) Millett notes that this form is common in the Malay region. It is very different from the original *Triloculina gracilis* of d'Orbigny and probably represents a species of the tropical regions of the Indo-Pacific.

Quinqueloculina polygona d'Orbigny, var.

(Plate 24, Figures 5, 6.)

Quinqueloculina polygona d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 198, pl. 12, figs. 21 to 23.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 431, pl. 90, figs. 3*a* to *c*; Carnegie Inst. Wash. Pub. 311, 1922, p. 68.

Test elongate; chambers distinct; sutures slightly depressed; chambers polygonal in transverse section, the periphery usually concave, with a projecting carina at either angle; apertural end extending into a short, cylindrical neck; aperture circular with an everted lip, and a single bifid tooth; surface usually dull.

Length of Samoan specimens up to 1.25 mm.

Specimens from stations 1, 2, 3, and 5.

The specimens are more angular than most of those from the West Indies. They might be referred by some authors to *Q. ferussacii* o'Orbigny but a study of his original Modèle shows that this a very different form.

Quinqueloculina species?

(Plate 23, Figures 5, 6.)

There are 2 specimens from station 2 which are here figured. They are the only ones of this particular form and I have hesitated to place them specifically.

Genus MASSILINA Schlumberger, 1893.

Massilina alveoliniformis Millett.

Massilina alveoliniformis Millett, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, figs. 5 to 7.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 584, pl. 45, fig. 15.—Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 69.
Spiroloculina asperula H. B. Brady (not Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 8, figs. 13, 14, (11?).
Massilina asperula Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 447.
Massilina alveoliniformis Millett, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, figs. 5 to 7.

Test much compressed nearly circular; early chambers quinqueloculine, later ones in a single plane, periphery rounded, chambers distinct; wall of sand grains with a porcellanous lining to the chambers; aperture very slightly exserted.

Length of Samoan specimens up to 1 mm.

Specimens from station 1.

The figure above referred to by Brady, himself, with a question, is not at all the form found in the Indo-Pacific and represented by his figures 13 and 14. Figure 11 is from the Faroe Channel in the Atlantic. Of the others, figure 13 is from *Challenger* station 218A, 16 to 25 fathoms, Admiralty Islands, and figure 14 is from Humboldt Bay, New Guinea, in 37 fathoms. Brady's other stations are off the Ki Islands, 129 fathoms, and in the Philippines, 95 fathoms.

Millett's specimens were from the Malay Archipelago, and I had it previously from three stations in the Philippines. Heron-Allen and Earland figure a specimen which is evidently the young stage before the spiroloculine chambers are added. Their material was from the Kerimba Archipelago giving a typical Indo-Pacific distribution for this species. I have had specimens from the Tortugas Region.

Massilina macilenta (H. B. Brady).

(Plate 24, Figures 3, 4.)

Miliolina macilenta H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 167, pl. 7, figs. 5, 6.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 399.
Quinqueloculina macilenta Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 55.
[?] *Massilina macilenta* Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 583, pl. 45, figs. 13, 14.
[?] *Massilina secans* d'Orbigny, var. *macilenta* Millett, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, fig. 4.

Test nearly circular, much compressed, periphery rounded, early chambers quinqueloculine, later ones spiroloculine; surface ornamented by obliquely longitudinal costæ; apertural end with a flaring lip, aperture elongate.

Diameter of Samoan specimens 0.4 mm.

Species from stations 3, 5, and 9.

Our specimens are almost identical with the figure given by Brady. His type comes from the South Pacific. He had the species from Nares Harbor, Admiralty Islands, 17 fathoms; Humboldt Bay, New Guinea, 37 fathoms, and off Honolulu, Hawaiian Islands, 40 fathoms. Chapman records it from outside the reef at Funafuti. Millett records it from the Malay region but his figure is not at all typical. Heron-Allen and Earland also record it from the Kerimba Archipelago, but again their figure seems to represent something other than the typical form of the species. Brady's figure, plate 9, figure 1, without specific name, probably also belongs here.

Massilina exsculpta (Heron-Allen and Earland).

Miliolina exsculpta Heron-Allen and Earland, Trans. Zool. Soc. London,vol. 20, 1915, p. 567, pl. 42, figs. 23 to 26.

"Test free, minute, thin-walled, often opalescent, having three chambers visible on one face and four or more on the other. Sutural lines deeply excavate and undercut, especially at the extremities of the shell. Chambers embracing, and crescentic in section, the individual chambers being narrow at the oral extremity and very broad and embracing at the aboral end of the shell. Chambers embracing, and crescentic in section, the individual chambers being narrow at the oral extremity and very broad and embracing at the aboral end of the shell. Furnished with a somewhat produced neck, sometimes lipped, and terminating in a toothless aperture regularly and constantly crescentiform. Surface highly polished, peripheral edges rounded. The chambers are set somewhat obliquely, * * *

"The appearance of this little shell is strikingly constant and characteristic, the sutures, which in most miliolids are marked by slight depressions or by flush or even limbate sutural lines, being entirely absent. The whole shell suggests a simple tube of crescentiform section, invariably narrowing towards the apertural end of each chamber, and coiled on itself in milioline fashion. * * *"

Length of Samoan specimens up to 0.4 mm.

Specimens frequent at station 9.

The authors described this species from the Kerimba Archipelago off Southeastern Africa and also record its occurrence at Vavau, Friendly Islands, in 16 fathoms.

Our material is very typical according to the description of the authors which is quoted here, more like their figure 24 than any of the others. The peculiar "cut-under" character of the apertural end is very marked, more so than in any of their figures. The adult chambers are opposite, giving a true *Massilina* character to the test.

Massilina crenata (Karrer).

(Plate 25, Figure 4.)

Spiroloculina crenata Karrer, Sitz. Akad. Wiss. Wien, vol. 57, 1868, p. 135, pl. 1, fig. 9.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 156, pl. 10, figs. 24 to 26.—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 225, pl. 1, figs. 42, 43.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, pp. 381, 398.—Dakin, Rep. Pearl Oyster Fisheries, Ceylon, 1906, p. 231.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 557, pl. 41, figs. 6 to 8.

Massilina crenata Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 57, pl. 20, fig. 2.; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 445; Carnegie Inst. Wash. Pub. 311, 1922, p. 69, pl. 11, fig. 6.

Test small, much compressed, oval in front view, early development quinqueloculine, adult chambers in a single plane; chambers long and narrow, margin of last-formed chambers crenulate, due to regular contractions or fractions of the chamber in the adult; aperture rounded.

Length of Samoan specimens 0.5 mm.

This is another species that has a wide Indo-Pacific distribution and is known from the West Indian region as well. Karrer's specimens were from the Miocene of Kostej in the Banat.

Massilina pacificensis Cushman, new species.

(Plate 24, Figures 1, 2.)

Test compressed, nearly as broad as long, periphery subacute, early chambers quinqueloculine, later ones in a single plane; wall slightly crenulate obliquely; aperture very long and narrow slightly oblique with a distinct lip.

Length of Samoan specimens up to 1 mm.

Type specimen from station 5; others from station 1.

This is very similar to the specimen Brady figures in the *Challenger* Report, Pl. 6, figs. 1, 2. I do not know where the original is from but probably from the South Pacific. This is not at all the same as the large flat form from the Mediterranean and which represents d'Orbigny's *Quinqueloculina secans.*

Massilina annectens Schlumberger.

There are numerous specimens from station 2 which may be referred to this species. I have had it from shallow water off Hawaii. The specimens figured by Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, pl. 42, figs. 42 to 45) are very close to this.

Genus ARTICULINA d'Orbigny, 1826.

Articulina antillarum Cushman.

(Plate 25, Figure 1.)

Articulina antillarum Cushman, Carnegie Inst. Wash. Pub. 311, 1922, p. 71, pl. 12, fig. 5.

Test elongate, early portion in the microspheric form milioline, in the megalospheric form *Cornuspira*-like, the remainder and larger portion of the test made up of a linear series of elongate chambers gradually increasing in size toward the apertural end; chambers truncate at the distal end, then somewhat fusiform, and the apertural end fitted with a broadly flaring lip; aperture circular, without a lip; surface of the chambers with several rounded, longitudinal costæ.

Length of Samoan specimen slightly more than 1 mm.

Specimens from station 9 only.

I originally described this species from the Tortugas region and these Samoan specimens except that the initial end in every case is broken are identical with them. This gives question to the other figured Indo-Pacific specimens referred to *A. conico-articulata* (Batsch) as to whether or not they may be *A. antillarum*. This especially applies to those of Heron-Allen and Earland from the Kerimba Archipelago and Millett's from the Malay region.

Articulina species?

(Plate 25, Figure 7.)

There is a single specimen from station 9 which is figured here. It is apparently an undeveloped *Articulina*.

Genus HAUERINA d'Orbigny, 1846.

Hauerina ornatissima (Karrer).

(Plate 24, Figures 7 to 9.)

Quinqueloculina ornatissima Karrer, Sitz. Akad. Wiss. Wien, vol. 58, 1868, p. 151, pl. 3, fig. 2.
Hauerina ornatissima H. B. Brady, Quart, Journ. Micr. Sci., vol. 16, 1876, p. 406; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 192, pl. 7, figs. 15 to 22.—Millett, Journ. Roy. Micr. Soc., 1899, p. 610.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 178; 1902, pp. 381, 399.—Dakin, Rep. Pearl Oyster Fisheries, Ceylon, 1906, p. 231.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 53.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 590.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 63, pl. 23, figs. 1, 5.; Bull. 676, U. S. Geol. Surv., 1918, p. 26, pl. 6, fig. 5; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 452; Carnegie Inst. Wash. Pub. 311, 1922, p. 72.

Test oval, compressed, early portion quinqueloculine, later spiroloculine or planospiral; peripheral margin subacute; chambers distinct; sutures depressed; wall with transverse crenulations; aperture cribriform.

Diameter of Samoan specimens up to 1 mm.

Specimens occurred at stations 1, 2, 5, 7, and 9.

The distribution of this species is very interesting. Karrer originally described and figured it from the Miocene of Kostej in the Banat. Brady had it from the shores of the Society and Fiji Islands and from the smaller groups off the coast of New Guinea and also off Ascension Island, off Mauritius, and elsewhere. Of his figured specimens I have records of the following: plate 7, figures 16 and 17 from *Challenger* station 218A, Nares Harbor, Admiralty Islands, 16 fathoms; figures 18 and 19 from Avalau, Fiji, 12 fathoms, and figure 20 from *Challenger* station 174C in 210 fathoms, off Kandavu, Fiji. I am indebted to Capt. F. A. Potts, of Trinity College, Cambridge, for these and other records from the Brady collection. Chapman records the species from the lagoon at Funafuti in 7.5 and 12 fathoms; from the ocean beach of Avalau Islet very rare, and at several stations outside the reef, 32 to 200 fathoms, at a number of which it was recorded as common. Dakin records it as very rare, south of Kodramallai, Ceylon. Herron-Allen and Earland record it as occurring sparingly at nearly all their stations in the Kerimba Archipelago.

Rhumbler had it from Laysan and I had it from Gaspar Straits and from 3 *Nero* stations off the Hawaiian Islands, 33 to 271 fathoms. Millett had it from several stations in the Malay region. I have had but a single record for its occurrence in the Philippine region, in spite of abundant material. There seems to be no records from the Australian region. It would therefore seem confined to the strictly tropical Indo-Pacific, with the extension which I have found in the West Indian region, where it occurs on the coast of Jamaica and the Tortugas region, linking this region with the Indo-Pacific. Still more interesting is its occurrence in the Caloosahatchee marl of Florida, which is characterized by tropical species.

Hauerina fragilissima (H. B. Brady).

(Plate 25, Figures 2, 3)

Spiroloculina fragilissima H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 149, pl. 9, figs. 12 to 14.—Chapman, Journ. Linn. Soc., Zool., vol. 28, 1902, p. 398.—Dakin, Rept. Pearl Oyster Fisheries, Ceylon, 1906, p. 230.

Hauerina fragilissima Millett, Journ. Roy. Micr. Soc., 1898, p. 610, pl. 13, figs. 8 to 10.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 587, pl. 46, figs. 1, 2.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 64, pl. 24, fig. 4.; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 638; Journ. Washington Acad. Sci., vol. 10, 1920, p. 200; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 451; U. S. Geol. Surv., Prof. Paper 129E, 1922, p. 103, pl. 27, fig. 3.

Test much compressed, nearly circular; early chambers quinqueloculine, later ones, which make up the larger part of the adult test, spiroloculine; periphery rounded; sutures very slightly if at all depressed; wall very thin, opalescent, the sutures standing out as white opaque lines; aperture cribrate.

Diameter of Samoan specimens 0.65 mm.

Specimens from stations 5 and 9.

This is an Indo-Pacific species with an extension into the Byram marl of Mississippi. Brady's records are as follows: "* * * is a rare coral-reef species. It occurs in two soundings off Tahiti, Society Islands, at 420 fathoms and 620 fathoms respectively; off Kandavu, Fiji Islands, 255 fathoms; at two stations on the south coast of Papua, 3 to 28 fathoms, and at two points on the north coast of the same island, 16 to 25 fathoms." Millett records it from the Malay region. Chapman had it from a single station outside the reef at Funafuti, very rare at 200 fathoms. Dakin records a single specimen off Ceylon, and Goddard from east of Sydney, in 80 fathoms. Heron-Allen and Earland note its occurrence in the Kerimba Archipelago as "generally distributed, but never more than an occasional specimen." I have had it from a single *Nero* station in 271 fathoms off Hawaii, from off New Zealand, and but two records from the Philippines, in 20 and 26 fathoms.

There are specimens which seem identical with this from the Lower Oligocene, Byram marl of Mississippi, where a number of other typically Indo-Pacific species have been found.

Genus TRILOCULINA d'Orbigny, 1826.

Triloculina tricarinata d'Orbigny, var. convexa Cushman.

Triloculina tricarinata d'Orbigny, var. *convexa* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 456, fig. 37 (in text).

Variety differing from the typical in the shorter test and convex sides. Length of Samoan specimens average about 0.35 to 0.40 mm.

Specimens are fairly common occurring at stations 1, 3, 4, 5, 6, 7, 8, and 9, as well as at the outer edge of the Aua Reef, Tutuila.

I originally described this variety from the Philippines, where it occurred at a number of stations. Heron-Allen and Earland mention a short form of this species occurring in their material from the Kerimba Archipelago, and the variety is evidently common in the Indo-Pacific.

Triloculina tricarinata d'Orbigny, var.

From four stations, 1, 3, 4, and 6, there are specimens of an elongate, slender form of this species.

Triloculina circularis Bornemann.

(Plate 25, Figures 5, 6)

Triloculina circularis Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 349, pl. 19, fig. 4.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 67, pl. 25, fig. 4; pl. 26, fig. 1, fig. 33, (in text); Carnegie Inst. Wash. Pub. 213, 1918, p. 290; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 638; Carnegie Inst. Wash. Pub. 311, 1922, p. 73.

Miliolina circularis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 169, pl. 4, figs. 3*a* to *c;* pl. 5, figs. 13, 14 (?).—Egger, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 235, pl. 2, figs. 61 to 63.—Chapman, Proc. Zool. Soc. London, 1895, p. 9.—Goës, Bull. Mus. Comp. Zöol., vol. 29, 1896, p. 82.—Millett, Journ. Roy. Micr. Soc., 1898, p. 499, pl. 11, figs. 1 to 3.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900, p. 173; Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 81.—Dakin, Rept. Pearl Oyster Fisheries Ceylon, 1906, p. 229.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p.121; Subantarctic Islands of New Zealand, 1909, p. 318; Journ. Linn. Soc. Zool., vol. 30, 1910, p. 397.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 26.—Pearcey, Trans. Roy. Soc. Edinb., vol. 49, 1914, p. 995.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 557.—Chapman, Biol. Results *Endeavour*, vol. 3, pt. 1, 1915, p. 8.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 8.—Heron-Allen and Earland, British Antarctic (*Terra Nova*) Exped., Zoology, vol. 6, 1922, p. 64.

Test rounded, the 3 visible chambers in the adult rounded and tumid; sutures distinct; whole test somewhat compressed, the last-formed chamber strongly embracing; wall smooth; aperture a crescentiform narrow slit with a large flattened semicircular tooth.

Length of Samoan specimens not over 0.5 mm.

Specimens from stations 1, 2, 5, and 6.

This is a very common species, very characteristic of coral-reef conditions, but also met with in temperate regions and south into the Antarctic.

Triloculina oblonga (Montagu).

At stations 1, 2, 3, 5, 6, and 9 there are specimens which in general may be referred to *Triloculina oblonga* (Montagu). They are as a rule more elongate and slender and the sides more nearly parallel than in the typical form of colder waters.

Genus BILOCULINA d'Orbigny, 1826.

Biloculina denticulata (H. B. Brady).

Biloculina ringens Lamarck, var. *denticulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 4, 5.—Millett, Journ. Roy. Micr. Soc., 1898, p. 262.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 398.—Dakin, Rept. Pearl Oyster Fisheries Ceylon, 1906, p. 228.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 551, pl. 40, figs. 11 to 13.

Biloculina denticulata Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 80, pl. 33, fig. 1; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 476, pl. 98, figs. 3*a*, *b*; Carnegie Inst. Wash. Pub. 311, 1922, p. 78.

Test elongate, roughly quadrangular in front view; in end view somewhat compressed, biconvex; apertural end broadly rounded; opposite end with a series of short, irregular teeth; wall smooth; aperture very broad and narrow, extending nearly the whole width of the test, the ends somewhat expanded, tooth long and narrow, making the inner border of the aperture plate-like, somewhat raised above the level of the surface to which it is attached, as is the whole border of the aperture.

Length of Samoan specimens up to 1.2 mm., average much smaller.

Specimens from stations 1, 5, and 9.

This is typically an Indo-Pacific species, but occurs also in the coral-reef region of the West Indies and the Cape Verde Islands. It is most abundant in comparatively shallow water.

Brady's records are from the Hawaiian Islands, 40 fathoms; off Tongatabu, Friendly Islands, 18 fathoms; off the Admiralty Islands, 15 to 20 fathoms; off Kandavu, Fiji, 610 fathoms, and off St. Vincent, Cape Verde Islands, 11 fathoms. Millett had it from the Malay region; Chapman from Funafuti; Dakin from Gulf of Manaar, and Heron-Allen and Earland from the Kerimba Archipelago. I have had it from shallow water in Apra Bay, Guam, from numerous stations in the Philippine region, and from the West Indian region of the Tortugas.

Biloculina denticulata (H. B. Brady), var. striolata (H. B. Brady).

Biloculina ringens (Lamarck), var. *striolata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 7, 8.—Chapman, Proc. Zool. Soc. London, 1895, p. 8.—Millett, Journ. Roy. Micr. Soc., 1898, p. 262, pl. 5, fig. 8.—Dakin, Rept. Pearl Oyster Fisheries Ceylon, 1906, p. 228.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 551.

Biloculina denticulata (H. B. Brady), var. *striolata* (H. B. Brady), Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 80, pl. 33, figs. 2, 3; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 477, pl. 98, figs. 2*a* to *c*; Carnegie Inst. Wash. Pub. 311, 1922, p. 78.

Variety differing from the typical in the addition of a surface ornamentation consisting of a series of costæ on the lower half of the penultimate chamber, occasionally on the ultimate also.

Specimens occurred at stations 2 and 3.

This variety is usually found with the typical form.

Biloculina millettii Cushman.

Miliolina durrandii Millett (part), Journ. Roy. Micr. Soc., 1898, p. 268, pl. 6, figs. 8 to 10 (not fig. 7).—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 565, pl. 42, figs. 11 to 16.

Biloculina millettii Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 81, pl. 34, figs. 4, 5; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 479; Carnegie Inst. Wash. Pub. 311, 1922, p. 77.

Test in front view broadly elliptical, in end view, compressed; chambers biconvex; the periphery with a definitely developed carina; wall typically smooth; aperture slightly produced, broadly elliptical, with a slightly thickened border joining the carina at its outer edge; the aperture with a small bifid tooth.

Length of Samoan specimens up to 0.75 mm.

Specimens occurred at stations 3, 4, and 6.

The distribution of this species is typically Indo-Pacific, with an apparent extension to the West Indian region.

Millett's material was from the Malay region. Heron-Allen and Earland figure a very fine series from the Kerimba region. They also note its occurrence on the coasts of Burmah, Queensland, Java, and Macassar and at Tahiti. I have had material from Hongkong Harbor and at one station in the Philippines, as well as the Tortugas region of the Gulf of Mexico.

Genus PENEROPLIS Montfort, 1808.

Peneroplis pertusus (Forskål).

All the specimens belong to this typical coiled form of the species. They occur only on the Aua Reef.

Genus ORBITOLITES Lamarck, 1801.

Orbitolites marginalis (Lamarck).

There are specimens of this species from stations 1, 2, 5, and 9, but they are not common.

Orbitolites duplex Carpenter.

Specimens of this species are common on the Aua Reef and at station 1, rare at station 9.

Orbitolites complanata Lamarck.

The only specimens that can be referred to this species are from the Aua Reef.

DESCRIPTIONS OF PLATES.

PLATE 1.

FIGS. 1. *Nouria harrisii* Heron-Allen and Earland. ×100.
2. *Haplophragmoides sphaeriloculum* Cushman. ×100.
3. *Carterina fulva*, new species. ×100.
4, 5. *Rotaliammina mayori*, new species. Fig. 4, ventral view; fig. 5, dorsal view. ×100.
6. *Textularia conica* d'Orbigny. Front view. ×100.
7, 8. *Textularia gramen* d'Orbigny. Front views. ×50.

PLATE 2.

FIGS. 1. *Textularia* sp.? Front view. ×100.
2 to 4. *Textularia foliacea* Heron-Allen and Earland. Fig. 2, apertural view; fig. 3, front view; fig. 4, side view. ×100.
5. *Textularia hauerii* d'Orbigny. Front view. ×75.
6, 7. *Textularia catenata* Cushman. Front views. ×75.

PLATE 3.

FIGS. 1. *Textularia foliacea* Heron-Allen and Earland. Front view. ×100.
2. *Textularia rugosa* (Reuss). Front view. ×50.
3, 4. *Bolivina vertebralis*, new species. Front views. ×200.
5. *Textularia siphonifera* H. B. Brady. Front view of young specimen. ×100.
6. *Lagena bicarinata* Terquem, var. Front view. ×100.

PLATE 4.

FIGS. 1, 2. *Bolivina simpsoni* Heron-Allen and Earland. Front views. ×100.
3. *Bolivina* sp.? Front view. ×100.
4, 5. *Textularia siphonifera* H. B. Brady. ×100. Fig. 4, young specimen showing twisted early portion and "siphons" not broken through; fig. 5, microspheric specimen, front view.
6. *Textularia* sp.? Front view. ×100.

PLATE 5.

FIGS. 1. *Bolivina compacta* Sidebottom. Front view. ×200.
2, 3. *Bolivina limbata* H. B. Brady, var. *costulata* Cushman. Front views. ×100.
4, 5. *Bolivina tortuosa* H. B. Brady. Front views. ×100.
6. *Bolivina limbata* H. B. Brady, var. *costulata* Cushman. Front view. ×100.
7, 8. *Bolivina tenuis* H. B. Brady. Front views. ×200.

PLATE 6.

FIGS. 1, 2. *Bolivina hantkeniana* H. B. Brady. Front views. ×100.
3, 4. *Bolivina mayori*, new species. Front views. ×100.
5, 6. *Clavulina difformis* H. B. Brady. Fig. 5, front view of broken specimen showing peculiar spinose character of later chambers; fig. 6, front view of complete specimen. ×100.
7 to 11. *Clavulina pacifica*, new species. Figs. 7, 10, triserial stage, apertural views views with aperture connected with the edge of the chamber; figs. 8, 9, apertural views of adult with aperture central; fig. 11, front view of adult. ×100.

PLATE 7.

FIGS. 1. *Mimosina echinata* Heron-Allen and Earland. Front view. ×200.
2. *Textularia folium* Parker and Jones. Front view. ×100.
3, 4. *Buliminoides williamsoniana* (H. B. Brady). Fig. 3, apertural view of specimen with unbroken end, fig. 4, front view of specimen with broken aperture. ×125.
5. *Trifarina bradyi* Cushman. Front view. ×150.
6, 7. *Uvigerina porrecta* H. B. Brady. Front views. ×150.
8. *Uvigerina interrupta* H. B. Brady. Front view. ×200.
9. *Cristellaria crepidula* (Fichtel and Moll). Side view. ×100.

PLATE 8.

FIGS. 1, 2. *Siphogenerina raphanus* (Parker and Jones). Fig. 1, front view of microspheric specimen with narrow pointed base; fig. 2, megalospheric specimen with rounded base. ×100.
3, 4. *Siphogenerina virgula* (H. B. Brady). Front views. Fig. 4, specimen with backward-pointed spines. ×100.
5, 6. *Siphogenerina columellaris* (H. B. Brady). Fig. 5, megalospheric specimen with rounded initial end; fig. 6, microspheric specimen with more pointed initial end and greater ultimate size of test. ×100.
7, 8. *Spirillina inaequalis* H. B. Brady. Fig. 7, dorsal view; fig. 8, apertural view. ×100.

PLATE 9.

FIGS. 1, 2. *Spirillina vivipara* Ehrenberg. ×100.
3. *Spirillina* sp.? ×100.
4, 5. *Spirillina limbata* H. B. Brady, var. *tuberculo-limbata* Chapman. Fig. 4, probably microspheric; fig. 5, megalospheric. ×100.
6, 7. *Spirillina spinigera* Chapman. Fig. 6, megalospheric form; fig. 7, probably microspheric form. ×100.

PLATE 10.

FIGS. 1. *Discorbis subbertheloti*, new species. Dorsal view. ×100.
2 to 4. *Cymbalopora bradyi* Cushman. Fig. 2, dorsal view; figs. 3, 4, ventral views. ×75.
5 to 7. *Cymbalopora tabellæformis* H. B. Brady. Fig. 5, side view; fig. 6, dorsal view; fig. 7, ventral view, all of different specimens. ×75.
8. *Tretomphalus bulloides* (d'Orbigny), var. *plana*, new variety. Dorsal view. ×75.

PLATE 11.

FIGS. 1 to 3. *Tretomphalus bulloides* (d'Orbigny). Fig. 1, ventral view of specimen with "balloon-chamber" removed; fig. 2, dorsal view of another apparently microspheric specimen; fig. 3, side view of large coarsely punctate specimen with "balloon-chamber." ×200.
4. *Tretomphalus milletti* (Heron-Allen and Earland). Side view. ×200.
5. *Planorbulina larvata* Parker and Jones. Dorsal view. ×75.
6, 7. *Truncatulina rostrata* H. B. Brady. Fig. 6, apertural view; fig. 7, side view ×100.
8. *Truncatulina tubulifera* Heron-Allen and Earland. Side view. ×150.

PLATE 12.

FIGS. 1, 2. *Truncatulina haidingeri* (d'Orbigny), var. *pacifica*, new variety. Fig. 1, dorsal view; fig. 2, ventral view. ×100.
3, 4. *Truncatulina mayori*, new species. Fig. 3, dorsal view; fig. 4, ventral view. ×100.
5 to 7. *Anomalina glabrata*, new species. Fig. 5, apertural view; fig. 6, dorsal view; fig. 7, ventral view. ×150.
8. *Siphonina echinata* (H. B. Brady). ×100.

PLATE 13.

FIGS. 1, 2. *Siphonina tubulosa*, new species. Fig. 1, ventral view; fig. 2, dorsal view. ×125.
3 to 5. *Pulvinulina peroblonga*, new species. Fig. 3, ventral view; fig. 4, side view; fig. 5, dorsal view. ×100.
6. *Pulvinulina mayori*, new species. Ventral view. ×200.
7, 8. *Pulvinulina favus* H. B. Brady? Fig. 7, dorsal view. ×200. Fig. 8, detail of surface. ×400.
9, 10. *Pulvinulina repanda* (Fichtel and Moll). Fig. 9, dorsal view; fig. 10, ventral view. ×100.

PLATE 14.

FIGS. 1, 2. *Rotalia venusta* H. B. Brady. Fig. 1, dorsal view; fig. 2, ventral view. ×125.
3. *Rotalia soldanii* d'Orbigny? Side view. ×100.
4 to 7. *Calcarina mayori*, new species. Fig. 4, specimen with elongate, somewhat club-shaped spines; fig. 5, ventral view of deeper-water form; figs. 6, 7, ventral views of shorter-spined form from the reef. ×50.

PLATE 15.

FIGS. 1 to 3. *Baculogypsina sphaerulatus* (Parker and Jones). Fig. 1, very young specimen with *Calcarina*-like form; fig. 2, young specimen in which the secondary development has begun to obscure the early chambers; fig. 3, adult specimen. ×50.
4. *Gypsina vesicularis* (Parker and Jones), var. *squamiformis* Chapman. Dorsal view. ×100.

PLATE 16.

FIGS. 1. *Nonionina scapha* (Fichtel and Moll). Side view. ×125.
2. *Nonionina subturgida*, new species. Side view. ×100.
3. *Nonionina umbilicatula* (Montagu), var. *pacifica*, new variety. Side view. ×100.
4. *Polystomella jenseni*, new species. Side view. ×125.
5. *Polystomella* sp.? Side view. ×125.
6. *Polystomella jenseni*, new species. Side view. ×125.
7, 8. *Polystomella milletti* Heron-Allen and Earland. Fig. 7, ventral view; fig. 8, side view. ×125.

PLATE 17.

FIGS. 1, 2. *Amphistegina radiata* (Fichtel and Moll). Side views. ×50.
3. *Amphistegina madagascarensis* d'Orbigny. Side view. ×50.
4. *Operculina gaimairdi* d'Orbigny. Side view. ×30.
5, 6. *Operculina bartschi* Cushman, var. *plana* Cushman. Side views. ×35.
7. *Operculinella venosa* (Fichtel and Moll). Side view. ×40.

PLATE 18.

FIGS. 1, 2. *Cornuspira involvens* Reuss. Fig. 1, microspheric specimen; fig. 2, megalospheric specimen. ×125.
3. *Nubecularia lucifuga* Defrance Attached specimen. ×75.
4. *Nubecularia tubulosa* Heron-Allen and Earland, var. *subdecorata*, new variety. Attached specimen. ×20.
5, 6. *Nubeculina divaricata* (H. B. Brady), var. *gracilis*, new variety. Front view. ×100.

PLATE 19.

FIGS. 1 to 4. *Nubeculina divaricata* (H. B. Brady), var. *advena*, new variety. Figs. 1 to 3, front views; fig. 4, apertural view. ×50.
5, 6. *Tubinella chapmani*, new species. Front views. ×100.
7, 8. *Tubinella funalis* (H. B. Brady). Front views. ×100.
9. *Fischerina pellucida* Millett. ×100.
10. *Nodobacularia tibia* (Jones & Parker). Last two chambers of broken specimen. ×100.

PLATE 20.

FIGS. 1. *Spiroloculina antillarum* d'Orbigny. Front view. ×100.
2. *Spiroloculina antillarum* d'Orbigny, var. *angulata* Cushman. Front view. ×100.
3, 4. *Spiroloculina grateloupi* d'Orbigny. Fig. 3, side view; fig. 4, front view. ×50.
5, 6. *Spiroloculina mayori*, new species. Fig. 5, front view; fig. 6, side view. ×100.

PLATE 21.

FIGS. 1. *Spiroloculina canaliculata* d'Orbigny. Front view. ×50.
2. *Spiroloculina eximia* Cushman. Front view. ×100.
3. *Spiroloculina affixa* Terquem. Side view. ×100.
4 to 7. *Quinqueloculina samoaensis*, new species. Figs. 4, 6, 7, front views; fig. 5, side view. ×100.
8. *Quinqueloculina alveoliniformis* (H. B. Brady). Side view. ×50.
9, 10. *Spiroloculina planissima* (Lamarck), var. *samoaensis*, new variety. Front views. ×100.

PLATE 22.

FIGS. 1, 2. *Quinqueloculina bidentata* d'Orbigny. Fig. 1, front view; fig. 2, side view. ×100.
3. *Quinqueloculina parkeri* (H. B. Brady). Front view. ×60.
4. *Quinqueloculina anguina* Terquem (?) Front view. ×100.
5, 6. *Quinqueloculina anguina* Terquem, var. *agglutinans* Wiesner. Fig. 5, front view; fig. 6, side view of another specimen. ×100.
7, 8. *Quinqueloculina disparilis* d'Orbigny, var. *curta* Cushman. Fig. 7, apertural view; fig. 8, front view of another specimen. ×100.
9. *Quinqueloculina kerimbatica* (Heron-Allen and Earland). Front view. ×100.
10. *Quinqueloculina striata* d'Orbigny (?). Front view. ×100.

PLATE 23.

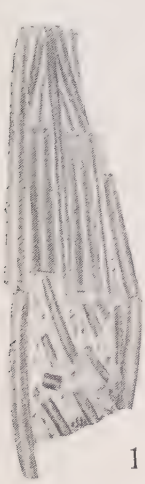
FIGS. 1, 2. *Quinqueloculina bicostata* d'Orbigny. Fig. 1, apertural view; fig. 2, front view. ×100.
3, 4. *Quinqueloculina undosa* Karrer. Front views. ×100.
5, 6. *Quinqueloculina sp.?* Fig. 5, side view; fig. 6, front view. ×100.
7. *Quinqueloculina crassa* d'Orbigny, var. *subcuneata* Cushman. Front view ×100.
8. *Quinqueloculina seminulum* (Linné). Front view. ×100.
9, 10. *Quinqueloculina tropicalis*, new species. Front views. ×100.

PLATE 24.

FIGS. 1, 2. *Massilina pacificensis*, new species. Front views. ×100.
3, 4. *Massilina macilenta* (H. B. Brady). Fig. 3, apertural view; fig. 4, front view. ×125.
5, 6. *Quinqueloculina polygona* d'Orbigny, var. Fig. 5, front view; fig. 6, side view. ×100.
7 to 9. *Hauerina ornatissima* (Karrer). Fig. 7, young specimen, front view; figs. 8, 9, adults, front views. ×60.

PLATE 25.

FIGS. 1. *Articulina antillarum* Cushman. Front view of broken specimen. ×100.
2, 3. *Hauerina fragilissima* (H. B. Brady). Front views. ×100.
4. *Massilina crenata* (Karrer). Front view. ×125.
5, 6. *Triloculina circularis* Bornemann. Fig. 5, front view; fig. 6, apertural view. ×100.
7. *Articulina* sp.? Front view. ×100.



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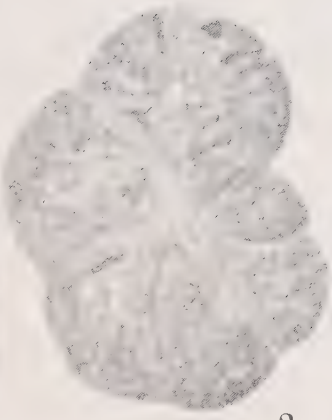

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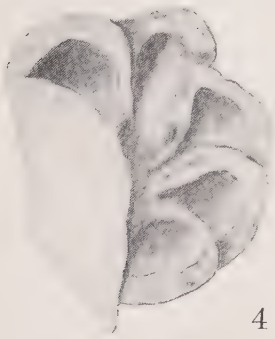

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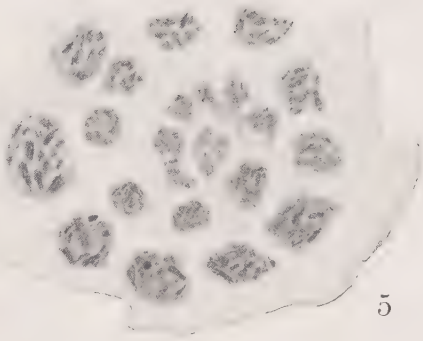

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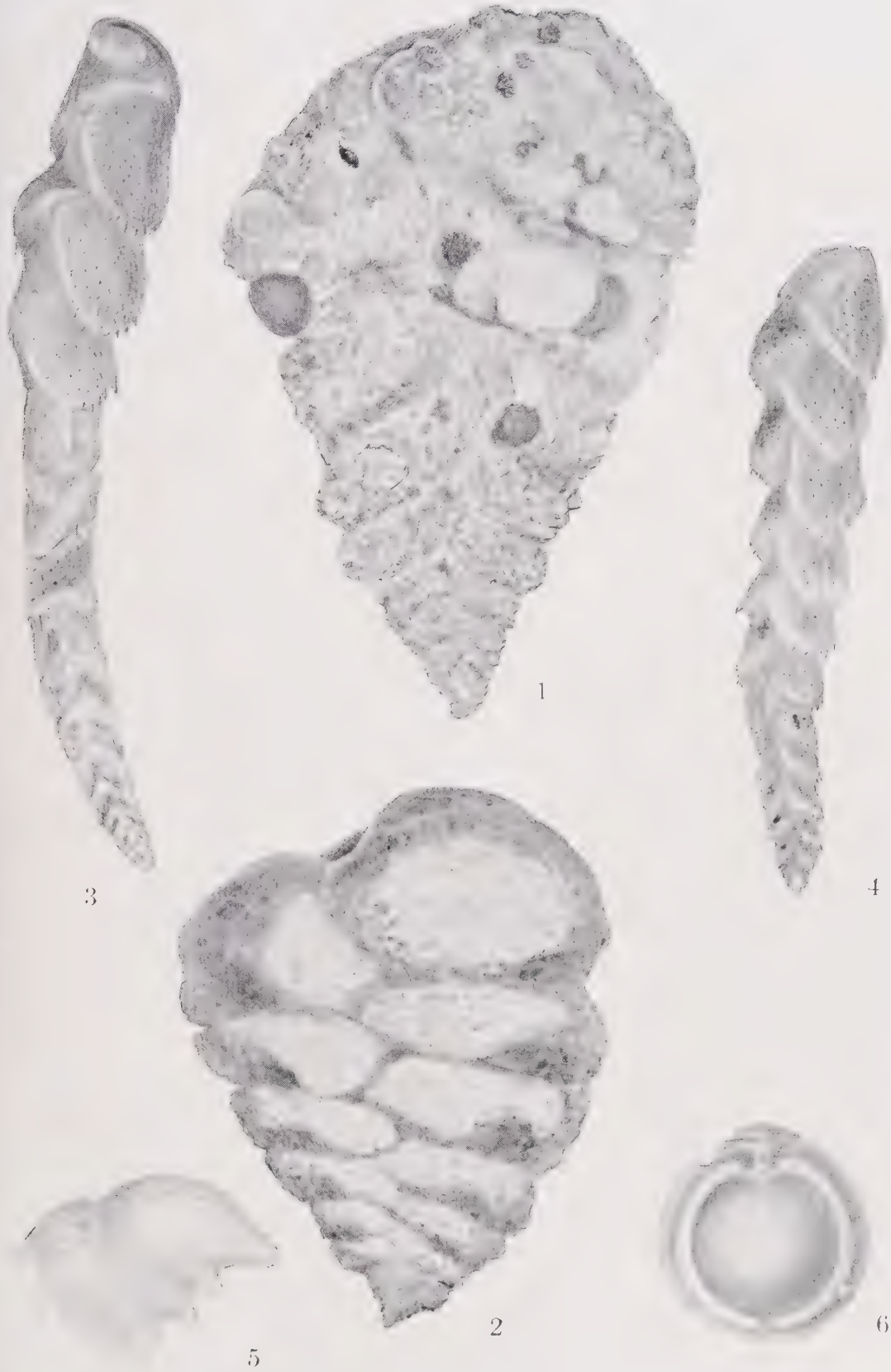
FIGURES 1 TO 8

FIGURES 1 TO 7



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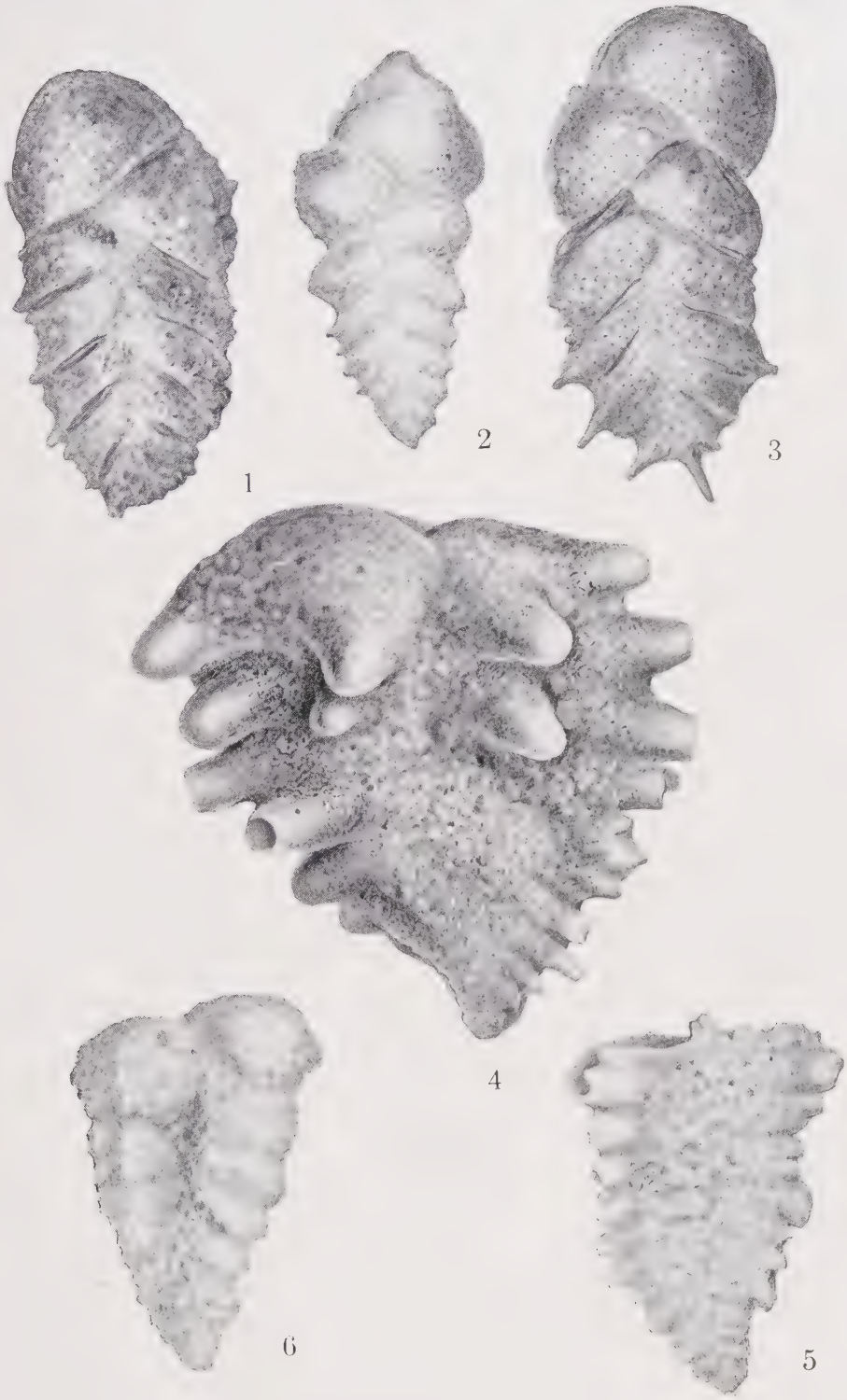

FIGURES 1 TO 6

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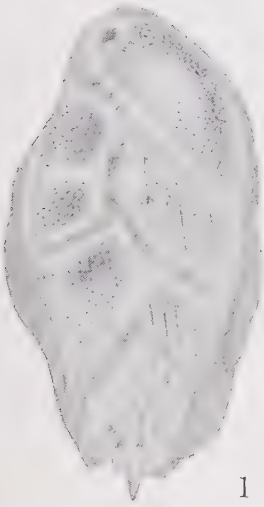

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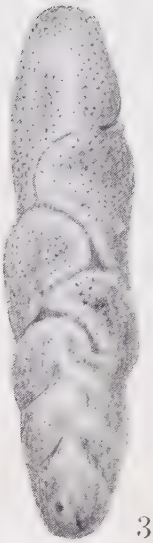

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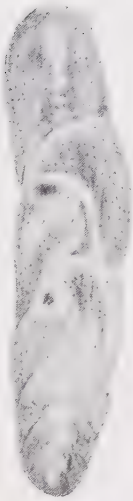

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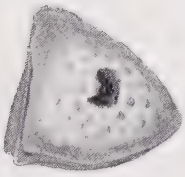

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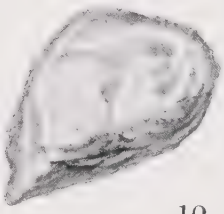

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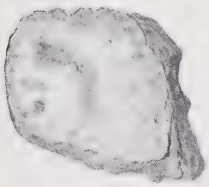

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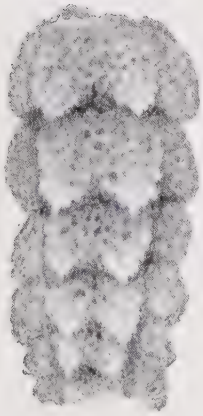

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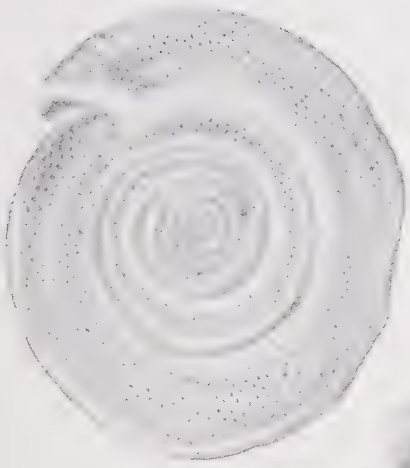
FIGURES 1 TO 11

FIGURES 1 TO 9

FIGURES 1 TO 8



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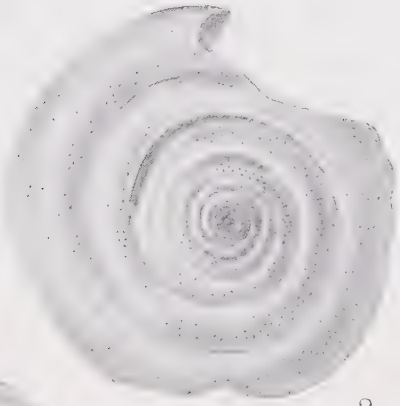

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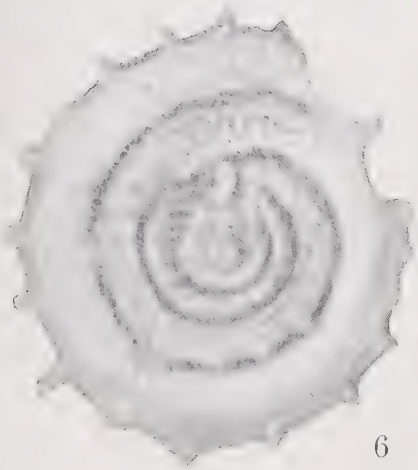

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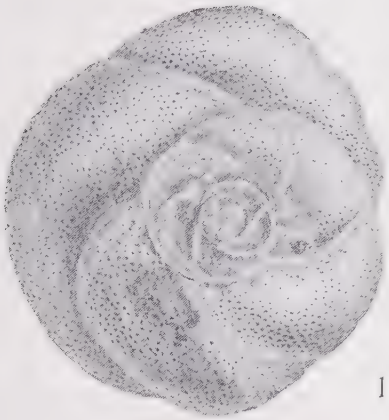

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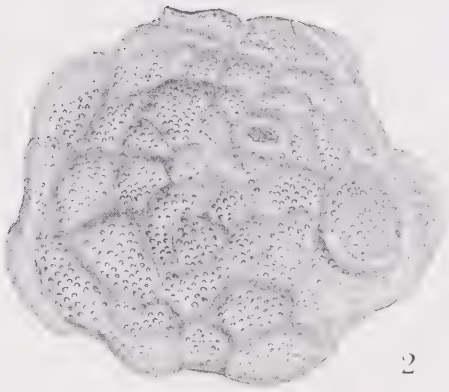

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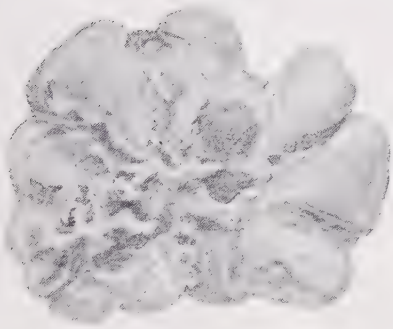

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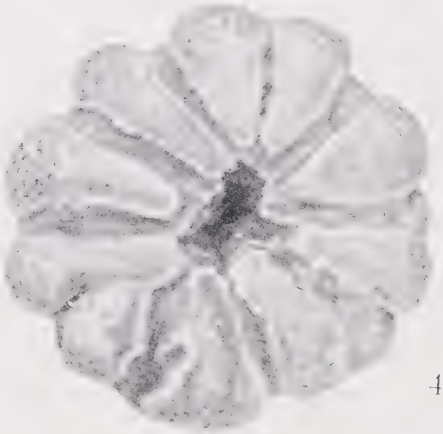

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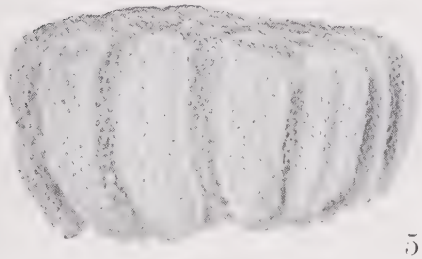

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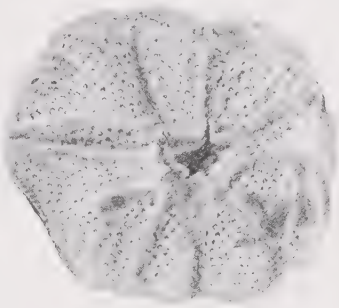

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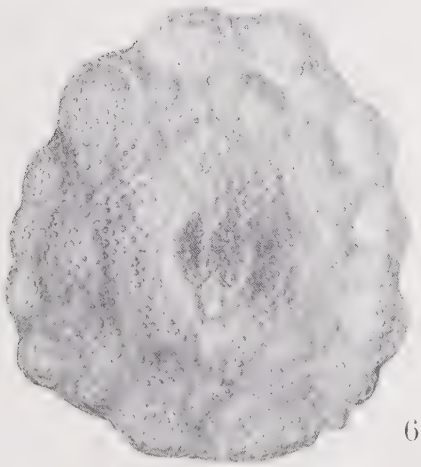

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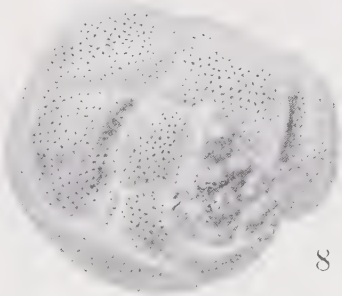

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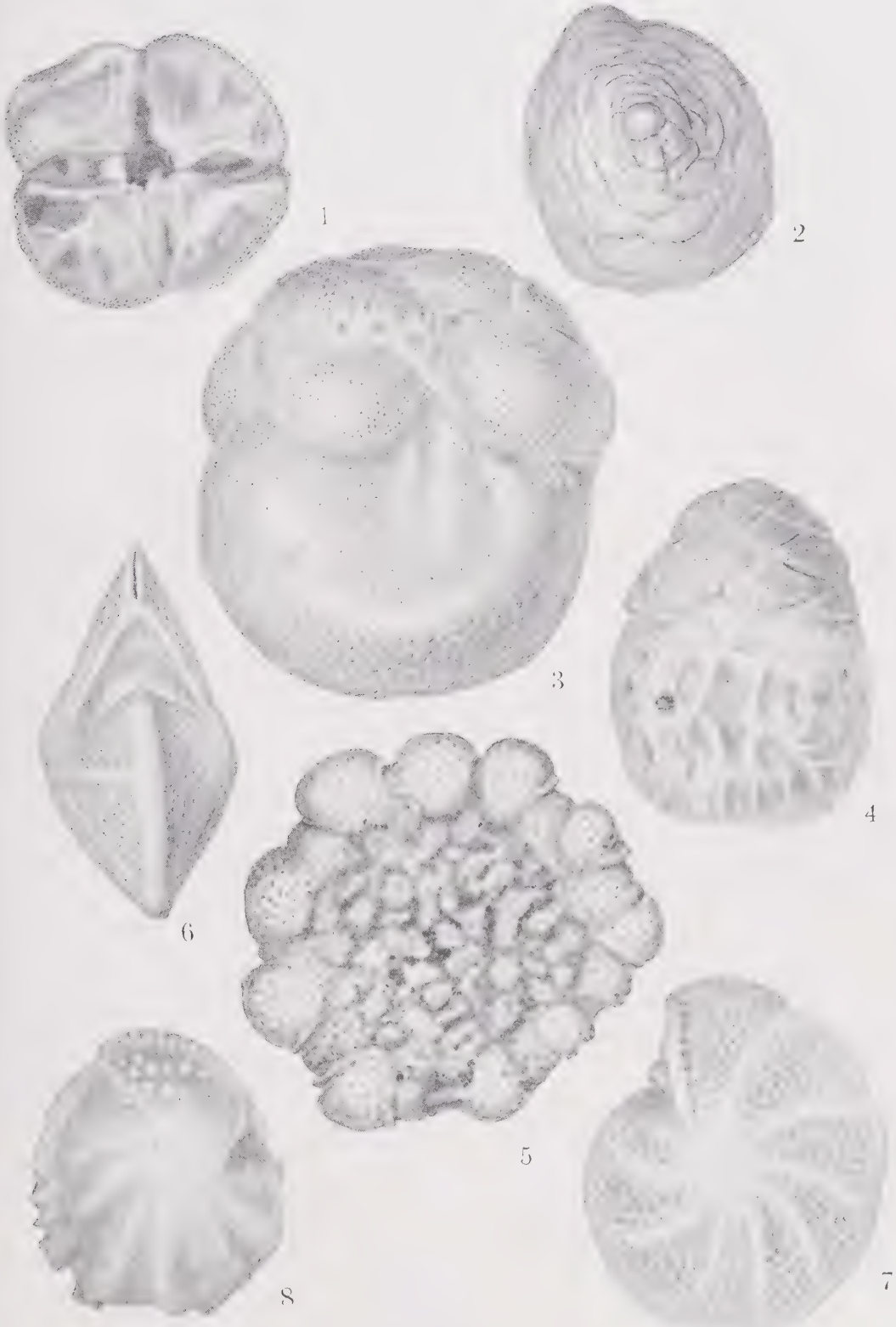

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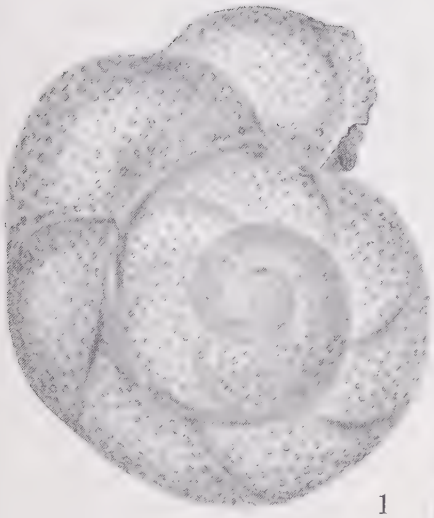

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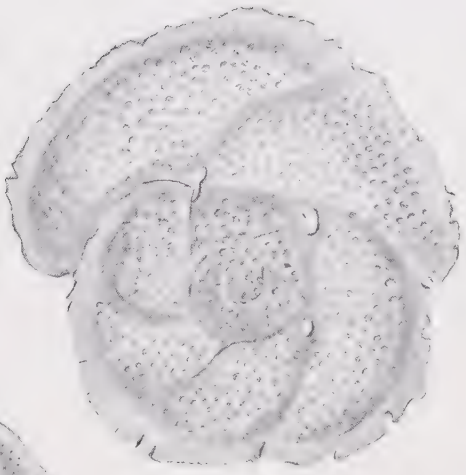

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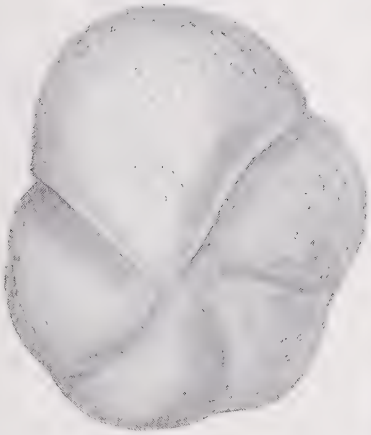

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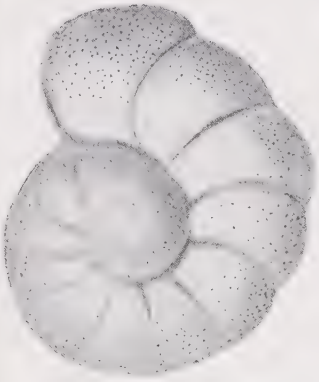

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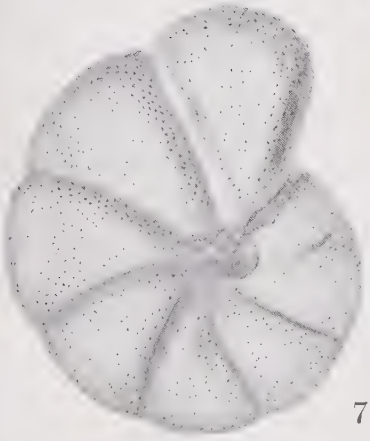

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FIGURES 1 TO 8

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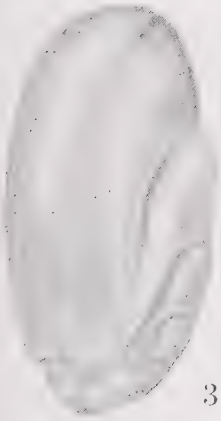

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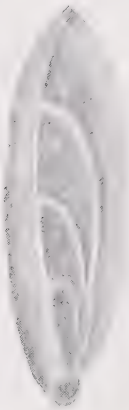

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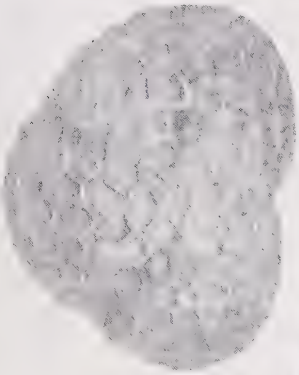

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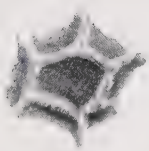

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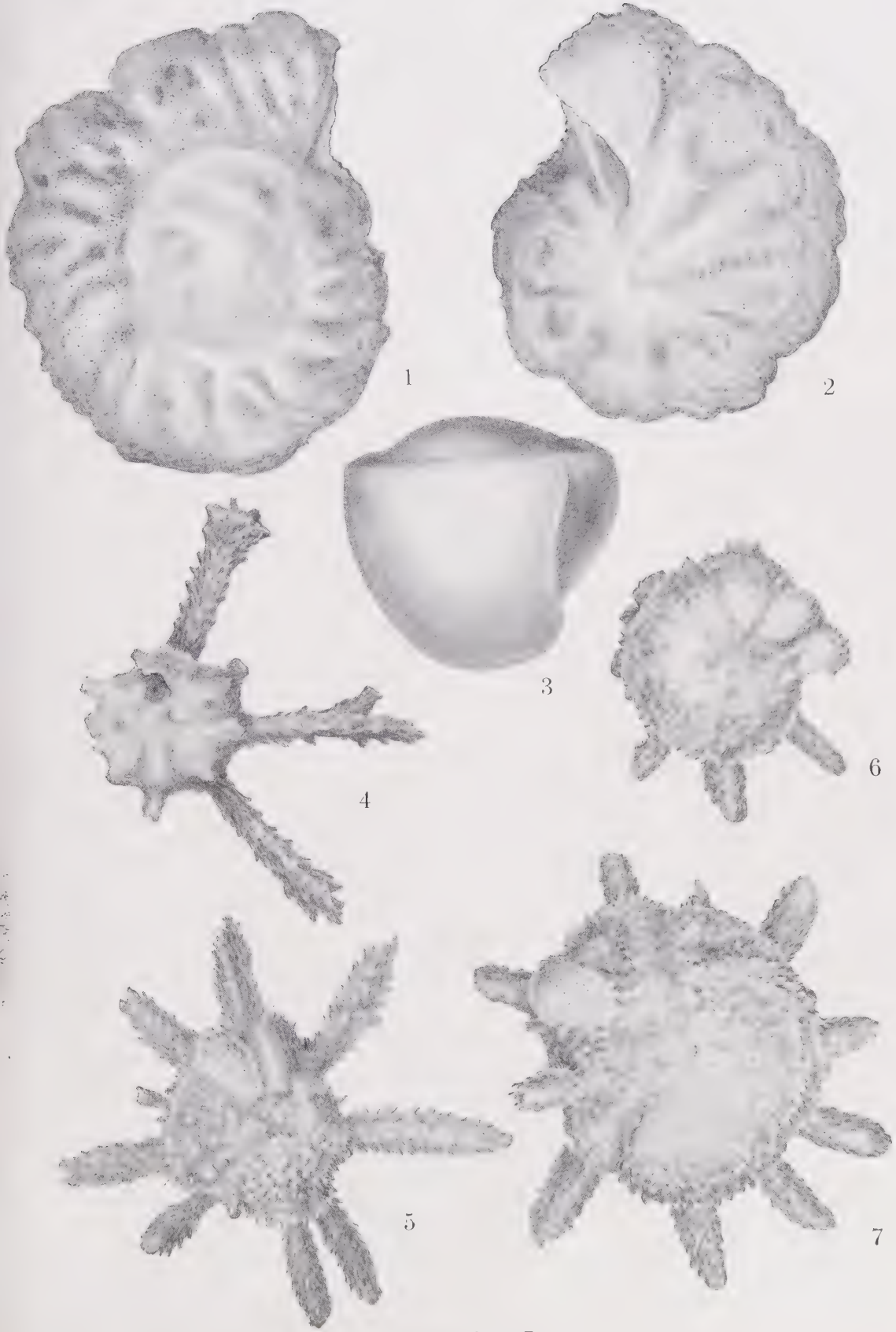

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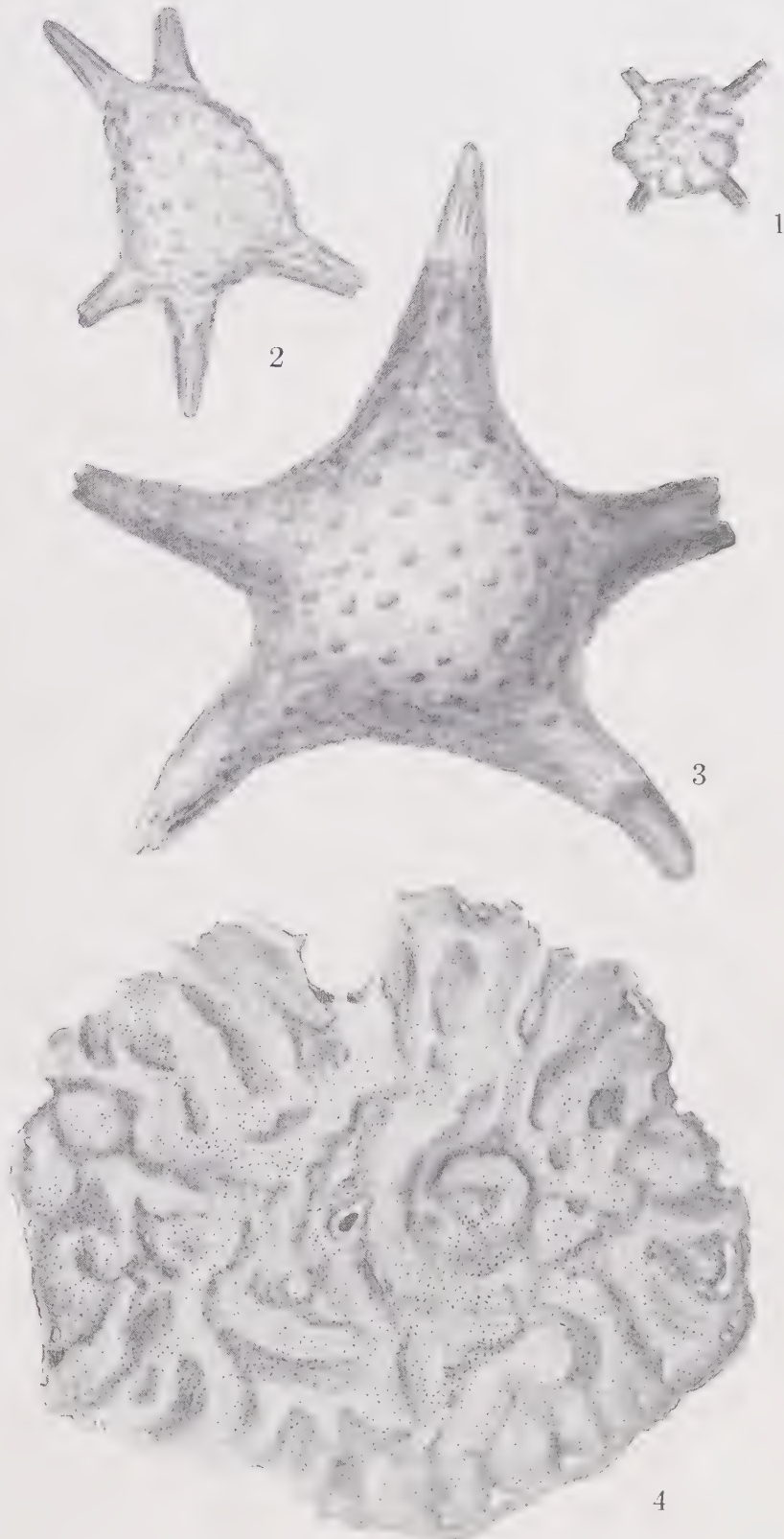

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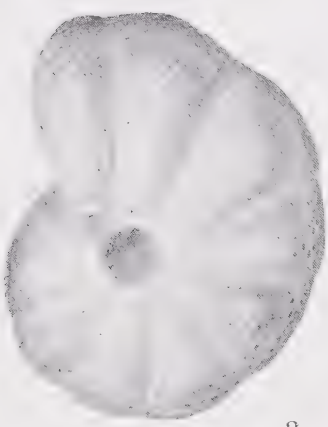

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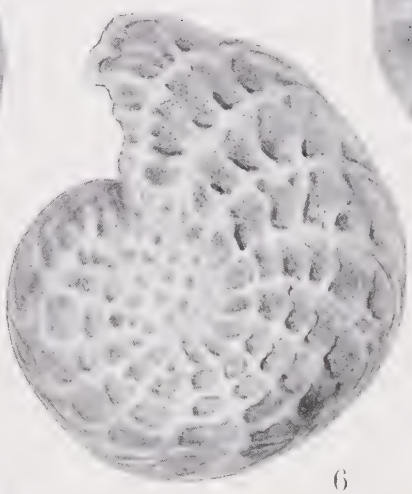

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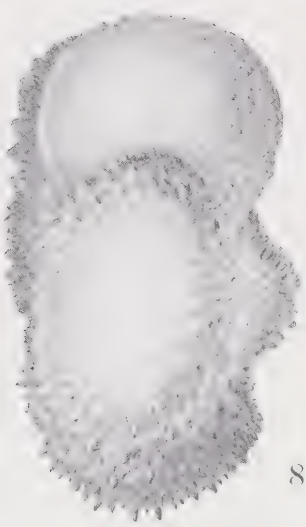

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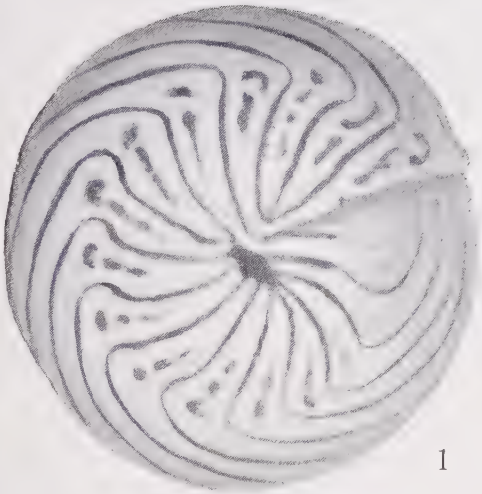

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FIGURES 1 TO 7

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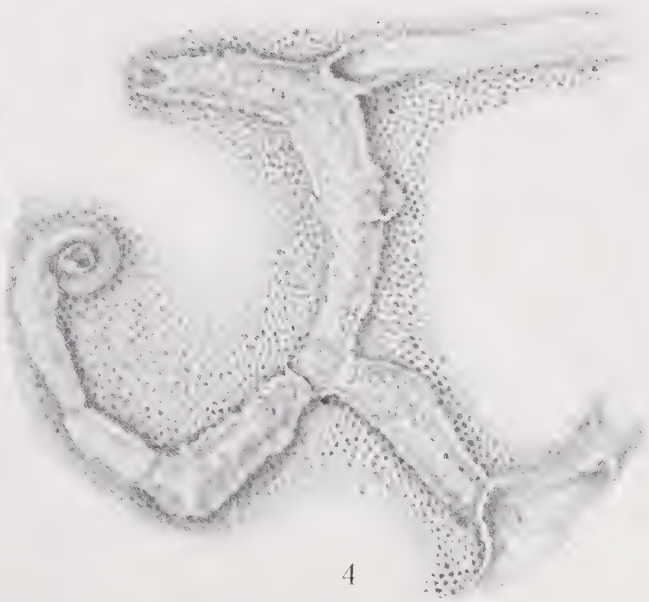

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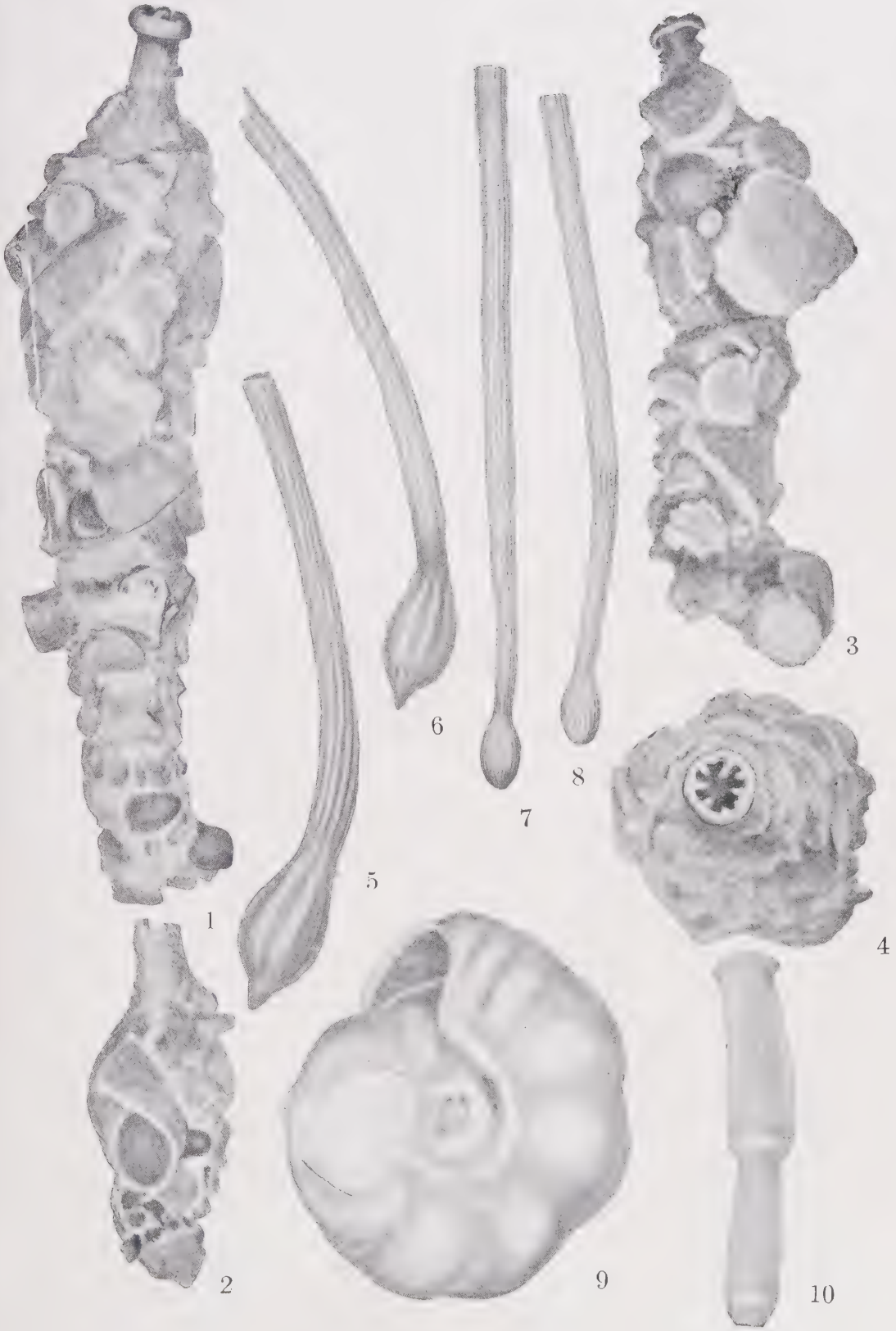
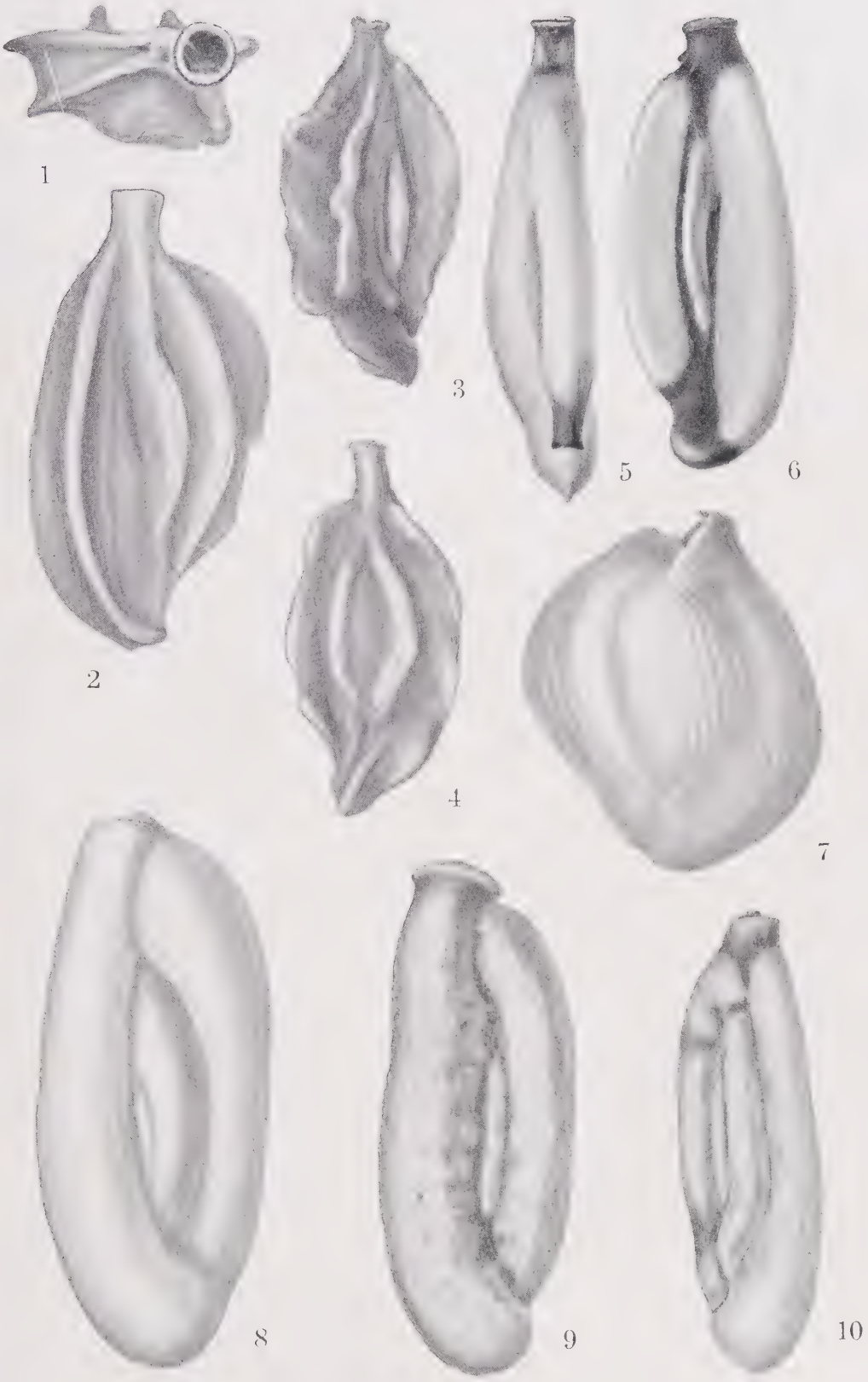


FIGURES 1 TO 10

FIGURES 1 TO 6

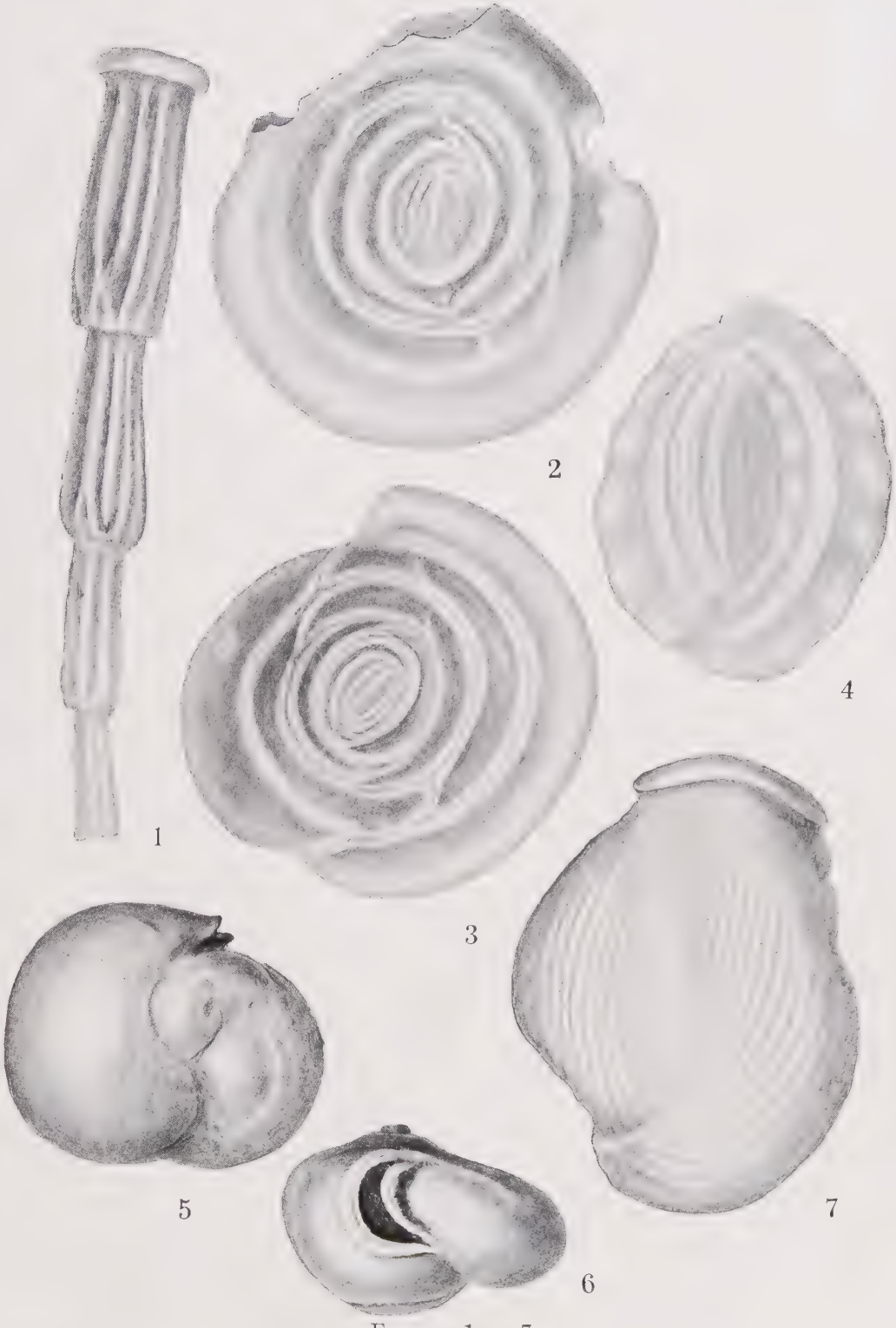
FIGURES 1 TO 10

FIGURES 1 TO 10



FIGURES 1 TO 10

FIGURES 1 TO 9



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